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The Cement Show

NO MATTER how well anything is done, it must be repeated often before it becomes a habit. This is true even of conventions and exhibitions. The Cement Show has been held so often and has been so well done that it can now be said to have become a habit, or rather that attendance thereat has become a habit. Engineers and contractors make an annual pilgrimage to Chicago in February to see what is new and to make up their minds what to use and buy during the next season. One can safely say that the show is now a permanent institution. It deserves the success it has won.

Planning for Clean-Up Week

CLEAN-UP WEEK has become a fixture in many cities. While the activity lasts but a week, the influence continues throughout the year. It is one of the many movements which, gaining headway during recent years, has helped to develop civic patriotism and a sense of responsibility to the community. For its immediate benefits as well as for its lasting influence, it behooves those in charge of the movement in each community to plan it carefully and to advertise it effectively. It is none too early to start now on plans. Already a considerable literature on this subject has been built up and is available through societies and publications devoting themselves to general civic movements. Reference to this literature will furnish an abundance of ideas, needing only individual initiative to give them life and force.

Standard Mixer Rating

WHILE the program which the National Association of Mixer Manufacturers has set for itself has been known for some time to those interested in the concrete field, it was not until the Cement Show last week that the association attempted to secure widespread publicity. Not only did it present its story well in advertisements in special numbers of journals distributed at the show, but gave further evidence of the new unity among mixer manufacturers by holding a joint exhibit. The work which has been planned cannot but be of value to the users of cement. Already the benefits of the standard method of rating are being appreciated. Now a 7-cu. ft. mixer (N. A. M. M. rating) is of a very definite size. What further advantages will come from co-ordinated efforts to improve mixing machinery, which is the next part of the program, can only be imagined; but judging by the caliber and progressiveness of the companies in the association one is justified in expecting much. But if the work is in the right direction—and this journal believes that it is—engineers and contractors should show their faith and approval—yes, and their appreciation—by adopting the rating standards, based on mixed-batch measurements, that have been agreed upon.

The Universal Language

RECENTLY we have sat in at three meetings for the discussion of the management of foreign labor. At one of these Prof. Michael I. Pupin, himself an immigrant (many years back, it is true) gave as his formula for the solution of the problem, "So treat the immigrant that he will love you. Gain his confidence by fair treatment and interest in his progress and welfare." At another meeting W. O. Hay, vice-president of the Northampton Traction Company, Easton, Pa., an employer of many foreigners, pointed out the advantage of the foreman or manager who can speak the tongue of his immigrant employee. But in lieu of such knowledge he urged the frequent use of what he termed the universal language—*the smile.* We believe the two ideas are fundamental and so important that they are worth passing on to all employers, even to those who do not employ immigrants. In fact there is no one, even though he be a solitary worker, with no one under his direction, who cannot serve his own interests by living in the spirit of these two suggestions. Fair play, the confidence of associates, the disposition toward one's fellows and one's work that displays itself in a smile will help win in any walk of life.

Natural Cement

SOMEWHAT less than a year ago attention was called in these columns to the efforts being made in the Middle West to regain for natural cement some share of the big market lost when the price of Portland started on its sensational drop. Latterly, Portland prices have been pulling away from natural again, and the margin is so great that one cannot afford to neglect consideration of the older but less used product. Those who are trying to increase the market for natural cement report good progress during the year. They find prejudice, of course—prejudice born of a lack of knowledge among engineers and contractors of the qualities of natural. In fact, even the manufacturers of the particular brand being promoted strongly in the Middle West had forgotten an important quality of their product—that it is non-staining. This has at once opened a large market for the cement in question—Utica. Now we hear that the division engineers of the

Illinois Highway Commission, impelled by the great difference in price between Portland and natural, have recommended that the latter be tried this year for pavement base. Certainly a reliable natural will give a good account of itself for that use. If the price difference remains much longer, other highway departments and also engineering organizations charged with work where mass concrete is used will be going back to the older product. It has high merit, and though brands vary in composition and set, and some brands themselves lack uniformity from month to month, the strength is satisfactory for mass work and there is no shrinkage on setting. The intrinsic merits of the product combined with the price differential may result in again establishing natural cement as an important engineering material.

The Place of Publication Work in Society Activities

"THE growth of the technical press, with its machinery for presenting quickly and concisely to the engineering profession and to the public at large the latest discoveries and the most recent achievements, has made unnecessary much of the work which was originally performed by engineering societies. Nevertheless, many of our newer associations persist in following along the old beaten track of publishing papers, not lifting their eyes from the ground and seeing the great neglected needs around them. Much of the money thus misused might better be expended in getting men together to discuss the present status and tendencies of affairs and to consider how best to help each other and the world in general."

These words, taken from an address delivered by Prof. F. H. Newell before the Cleveland Engineering Society, Nov. 21, 1916, express a thought that has been emphasized previously in these columns. The publishing and discussion of technical papers is generally one of the specified objects of engineering societies. Being a definite and specified object, its propriety as a function of the society and its place in the budget has seldom been questioned. This has been unfortunate, for, as this journal has shown, many papers have been printed that were a waste of funds. One has but to examine the financial statements of some of our national organizations and note that $50,000 and upwards is spent by individual organizations each year in printing to realize that no organization of scientific men should permit the practice to go on without a very careful scrutiny of the efficiency of the expenditure.

Personally, we agree with Professor Newell that in many cases funds had better be diverted to other ends. Were standards as strict as those of first-class technical journals adopted by the national societies the volume of their publications would shrink greatly. In saying this, we fully recognize that there must be some agency through which original research can be given to the profession, but original research has formed less than half of the data published by our national societies and cannot be advanced as a defense by the proponents of the extensive publishing interests of these organizations.

Road Work with Convicts

EVEN allowing full value to the fact that selected men were used in the model convict road camp maintained under the director of the Office of Public Roads by Fulton County, Georgia, and described on page 250, the results obtained warrant an extension of this work to other locations and an application of the experience so gained to a wider area and to larger units. Certainly, the year's experiment has justified its cost, and if many counties, or even perhaps a state, do not carry on the work, it will be only because of a lack of appreciation for economy and humanitarian penology.

The economy has been proved beyond the possibility of doubt. More actual work was accomplished than under the system of gun-armed guards, chain gangs, and flogging. The unit costs were lower than for similar work handled with free labor. Sickness and disease were avoided to a truly remarkable degree, and by applying only the simplest sanitary precautions. There were no attempts at escape, even though certain sections of the work were as much as 4 miles from the camp and in spite of the fact that the only locked door in camp was to prevent peculation from the commissary.

When it is kept in mind that this experiment was not run for any "sob-sister" reasons but merely to attain a set of data of practical applicability, the results are gratifying. Inasmuch as it meant a journey into strange fields, the first year's work has answered so many moot questions that there should be no shadow of uncertainty as to the soundness of reasoning and carefulness of preparation.

It is refreshing to realize, too, that there are men of talent who are devoting much or all of their time to the care of that percentage of derelicts which every community produces, and to the utilization of their time in such a way as to make to the community some recompense for the harm they have done.

Local Pride and Inefficiency

A NEW City Hall is to be built shortly in Macon, Ga., and the council has taken action barring all but Macon firms from bidding. This action can mean only one thing—that outside contractors would do the work for less than the local firms care to bid. Either the local firms are inefficient or they are bent on extracting a profit of undue proportions from the city. We take it for granted that the administration is honest and therefore do not suggest that any ulterior personal motives may have prompted the action.

In the case of road construction, a community may be justified in expending money to teach local contractors the business, as the entire territory will profit eventually from this policy. However, building work, unlike road construction, is in an advance stage of specialization. This excuse, therefore, cannot be offered by the Macon Council. If the builders of the city are not already up to standard in their calling, such action as this will never put them there.

Perhaps the theory of "keeping the money at home" is being given undue emphasis. Every community should take a pride in its own upbuilding, but to attempt to do it by nursing inefficiency is merely to encourage lower standards that must eventually be hurtful to the life of the community. Moreover, the slogan, "Keep the money at home!" is frequently used to throw dust into the eyes of the unthinking. The wages of the labor, the cost of the material furnished locally and the bulk of the overhead expense on a construction project are, of course, turned right back into local circulation. Only a relatively small per cent of the cost of improvements is taken away by an outside contractor. And if he can bid so much below local firms that the latter have to be protected in their own backyards by city ordinance, then the outsider can evidently save the taxpayer a sum which will make it to the advantage of the city to let him carry off a little profit.

Is Macon still living in the last generation?

To Improve Structural Organizations

WHILE recognizing that any form of organization is dependent quite as much upon the personnel of the workers as upon details of function and operation, particularly in the case of engineering work where technical ability is of primary importance, fundamental principles which should be applied in the field of structural design and detailing are too generally violated. Before considering some of these principles, it should again be emphasized that in the actual selection of men to fill vacancies occurring in all engineering organizations, the essential requirements should be technical skill and experience. While personal characteristics, such as initiative, enthusiasm, good habits and clear thinking, are also requisite, the proper balance between these and thorough technical training should always be insisted upon—in fact, continuous devotion to technical work in itself results in initiative, enthusiasm and other requirements which writers on efficiency too often consider as qualities to be developed in some special manner by extraneous means.

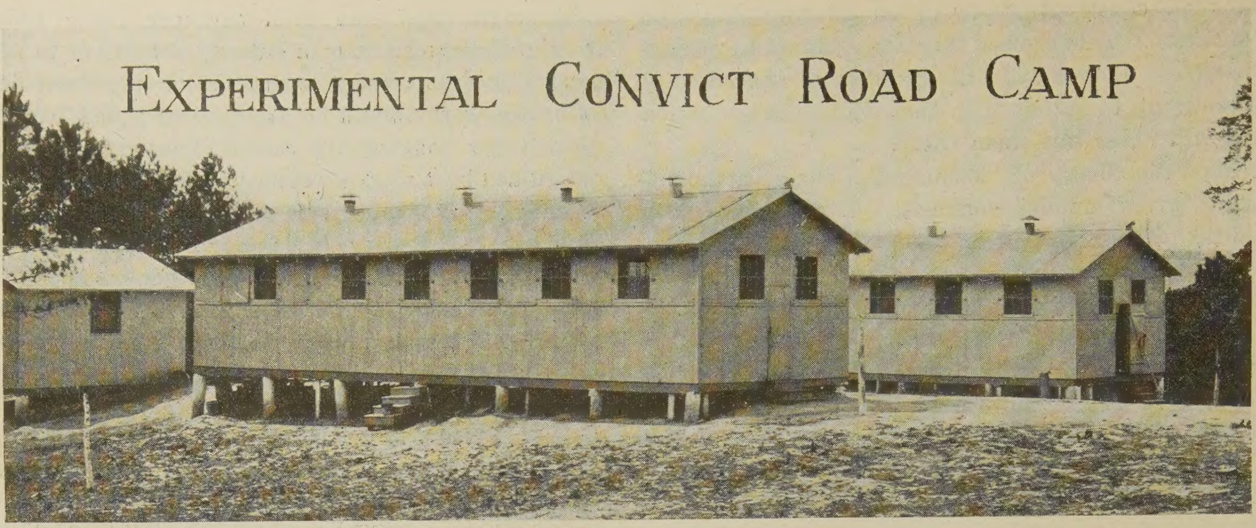
Granting that the body of workers in a drafting room or a designing office are technically equipped, each for his particular job, there is undoubtedly a wide variation in the amount and quality of the work done under different systems of organization or management. It is a serious question whether the general practice now followed in American fabricating companies or in large consulting engineers' offices even approaches that degree of efficiency which is being attained in other organizations. Some of those principles of management which apply particularly in this field should therefore receive serious consideration.

In the first place, there should be centralized control by a single head—the chief engineer, chief designer or chief draftsman, a man entirely competent to decide general questions and also matters of important detail. Extensive work should be assigned to squads carefully selected for congeniality and complementary abilities and guided by a working leader or "squad boss" capable of stimulating his men to their best efforts without driving them. Proper checking should be insisted upon, either by the separate check of another member of the squad familiar with the work in the case of detailing, or by the designer himself in the case of design work. There should be, also, recorded decisions on all important questions and a general checking during the progress of the design by the chief designer. To prevent mental fatigue, there should be rest periods, fresh air, stimulating exercise, quiet working conditions—all of which are of the utmost importance in brain work of this kind. Finally, the men should be stimulated by bonus payments for all work rapidly done.

The particular details of the application of these principles to any organization can best be worked out for each case according to the special requirements of the organization. Several pitfalls should, however, be carefully avoided. While simple and easily made records of all work, or a log of the operations and decisions or orders on each job, should be kept in permanent form, the use of too much red tape, multitudinous red, blue or green index or filing cards and the multiplication of clerical operations will often counteract the usefulness of any system. Unnecessary expenditures in this direction should be eliminated; in fact, one of the most effective means of creating profits for any large organization lies in the employment of a "watch dog" for expenditures, who will know enough of all the details of the work being done to stop the leaks and excess costs which are almost sure to occur without supervision. By thus reducing wasteful expense it is often possible to create the funds for bonus payments and thus answer the argument sometimes raised against the bonus system.

A really worth-while system rewarding suggestions for improvements in work or methods and encouraging the workers themselves to make such suggestions will often transform the spirit of an organization, provided these suggestions are properly handled, and the reasons for adoption or rejection carefully stated. In a word, complete co-operation between those who give orders and those who actually do the work is the well-recognized basis for all successful organization. A workable system of profit sharing, immediate in application and fair in distribution, should form a part of the plan—and by no means the least important part in these days when salaried men must perform some difficult mathematical computations to extend income to meet expense. Now that preparedness for exceptional competition after the war is so much discussed, the management of engineering organizations must apply fundamental principles of efficiency or run the risk of losing out in the more strenuous times which are predicted.

EXPERIMENTAL CONVICT ROAD CAMP



Model Camp of Office of Public Roads in Fulton County, Georgia, Is Described, and Some of the Reasons for Its Successful Operation Are Detailed

By GEORGE D. STEELE
Consulting Highway Engineer, Philadelphia

WITH the rapid strides that have been made in highway construction throughout the United States during the past several years, there has been a correspondingly increased interest taken in the subject of the utilization of prison or convict labor. There have been several reasons for this—some selfish and others purely for the moral and physical uplift of the unfortunates who have been so employed.

It is only a few years ago that the use of convict labor was almost exclusively confined to a few of the Southern states, where, it is safe to say, except possibly in a few rare instances, the use of this labor was planned with the intention of securing highway improvements at little or no more cost than was necessary for the housing and feeding of the prisoners in the prisons. In these early cases the gang system was generally used, the men working in stripes, usually in chains and under guards who were heavily armed. But state after state has taken up the utilization of convict labor in recent years, until it is now common in all sections of the country. With the growth of the use of this class of labor, conditions from the prisoners' standpoints have improved materially, though there is still room for much more improvement.

OFFICE OF PUBLIC ROADS INVESTIGATES

With the marked increase in the utilization of convict labor and the establishment of many additional camps, the Office of Public Roads and Rural Engineering became interested and a small appropriation for investigating the utilization of convict labor in road management was made in 1914. Representatives of the Office of Public Roads and Rural Engineering, together with representatives of the U. S. Public Health Service, visited convict camps in all parts of the United States, studied the construction of the camps, the feeding and clothing of the men, the systems of guarding them and the work accomplished. These visits were supplemented by data secured from the governors of states, from state highway commissioners and from the prison authorities. An idea of the scope of these studies may be had when it is mentioned that they were made in New York State, New Jersey, Michigan, Colorado, Wyoming, Utah, Oregon, Washington, Arizona, New Mexico, Texas, Alabama, Georgia, Florida, North Carolina, South Carolina and Virginia.

SCOPE OF WORK IS COMPREHENSIVE

The studies referred to covered "the management, operation, discipline and results obtained in convict road camps throughout the United States, in order that a report might be issued which will be helpful to the states and counties in the management of convict road camps, in determining the character of structures necessary and the proper method of erecting the same, in the selection and use of equipment, and in the handling of the various questions of sanitation, diet and clothing, so as to secure the best results commensurate with the welfare of the convicts." This covered the inspection of camps and the collection of data, and was practically completed during 1915. The scope of the work was enlarged during the fiscal year 1915-1916, when an appropriation was asked for "to study the management, operation, discipline and results obtained in convict road camps, and to test, under co-operative arrangements with state and local authorities, systems of record and cost keeping, and management devised by the Office of Public Roads and Rural Engineering."

The result of this work was so interesting and of such value that it was decided to extend it in such a manner that direction and supervision, in the main, should be under the Office of Public Roads. An appropriation was made in 1915 "to ascertain by observation of a camp constructed and operated as an experimental camp, the most practical structures, equipment, sanitation, clothing, diet, organization, discipline and methods of management to be used in connection with the use of convicts for road construction," and it was decided to select a camp in a county which would conform to the plans and suggestions formulated by the Office of Public Roads and the U. S. Public Health Service. The representatives of the office were to make careful observation of the results obtained in the management of the camp, the cost of operation, the effects upon the prisoners and the economic results to the county.

GEORGIA CONDITIONS CONSIDERED BEST

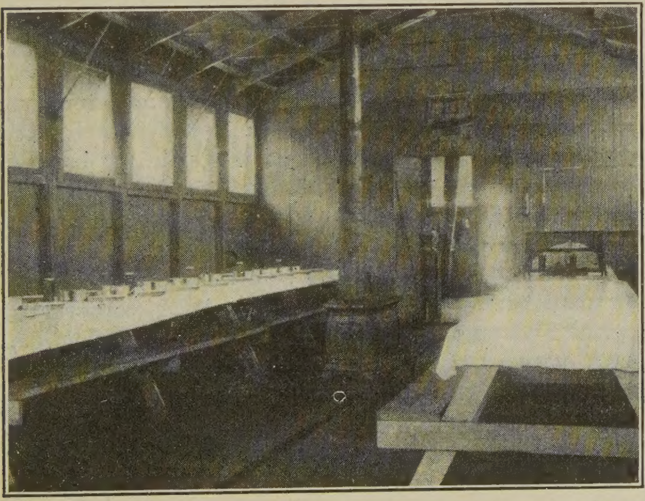
Late in December, 1915, Seaborn, Fulton County, Georgia, was selected for the establishment of this experimental camp, and the recommendations of the Office of Public Roads and Rural Engineering with reference to structures, management, records, etc., were followed, and the recommendations of the Public Health Service adopted as to sanitation, diet and health conditions. The county board of commissioners agreed to bear the entire expense of the camp, except the salaries of three of the officials and employees, who were to obtain the particular data desired from the investigation and to see that the recommendations of the office were strictly carried out. The government had, therefore, control over the location and erection of all buildings, the source and distribution of the water supply, all surveys for road work to be attempted, the entire system of cost accounting, the selection and distribution of rations, the disciplining of the men inhabiting the camp, the furniture and equipment, and other minor details.

The average population of the camp since it was established, Jan. 10, 1916, has been forty men convicts per day. With but three or four exceptions, these have been negro misdemeanor prisoners whose sentences average between seven and eight months, and who were secured from the Fulton County prison.

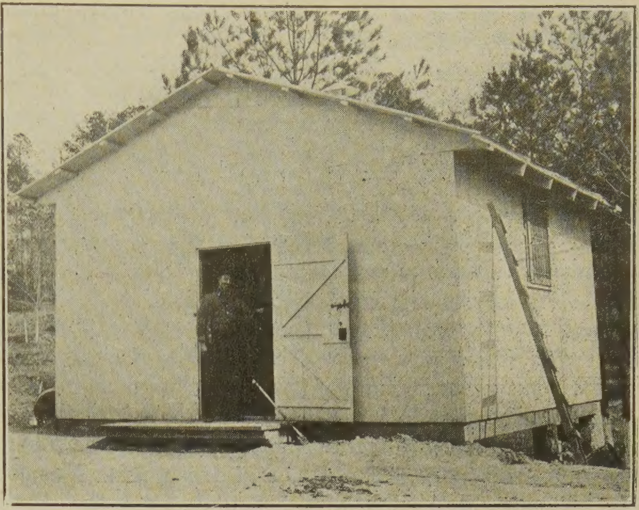
NO CHAINS OR FIREARMS USED

The officials of the camp consist of a deputy warden, two foremen, one camp clerk and one night watchman, whose only duties, so far, have been to protect the commissary. The men are all employed under the honor system, no armed guards being permitted at this camp.

All the prisoners are clothed in neat brown suits marked with the prisoner's number. There have been no escapes or attempts at escape up to the first of this year, although about one hundred different men have been quartered at the camp in the year of its operation. Only three of these have been sent back to the prison or to the chain camps, the only methods of disciplining that are used; two of these being returned for fighting and the third for the general dissatisfaction which he gave and caused. The authorities at the experimental camp are not allowed to flog the men, and it is worthy of mention that this is the only convict camp in Georgia where whipping of the prisoners for infractions of the rules is not permitted. The men are treated as human beings and are allowed practically all the privileges of a free labor camp. There are no barred windows, chains or locked doors, except on the commissary building.



THE KITCHEN END OF THE MESS QUARTERS SHOWS THE PORTABLE CONSTRUCTION



THE COMMISSARY IS THE ONLY BUILDING WITH LOCKS AND BARS

MEN GRANTED UNUSUAL LIBERTIES

The privileges that are granted to the men are unusually liberal. The time from their return from work late in the afternoon until they go to bed at night is theirs to do with as they please, either inside or outside the buildings. Saturday is a half-holiday throughout the summer, and is usually a gala day on which there are baseball games and other sports. A phonograph with a supply of records is placed in the building used as the sleeping quarters, writing tables are conveniently located and books and magazines are there for all who care to make use of them. The men are permitted to write and receive as many letters as they wish, although all correspondence is read by the authorities before it is mailed out or delivered to the prisoners.

The food is more varied and of a better class than is furnished to prisoners of any other camp in the state. This has been voluntarily attested to in every case where a prisoner was brought to the experimental camp after he had been in one of the others. One of the prisoners serves as cook, and his sole duty is the preparation of the meals. The steward, who is also the camp clerk, is not a prisoner.

The quantities of food for each man have been scientifically worked out and are closely adhered to. The menu is varied, however, as may be noted from the accompanying table, which shows the average number of ounces of the various foods which constitute the daily rations per man.

Daily Rations per Man, in Ounces

Beef	14	Turnips	12
Corned beef	12	Cabbage	12
Salt pork	8	Onions	12
Fresh fish	12	Carrots	12
Salt cod	5	Greens	12
Salt herring	5	Eggs	2
Salt mackerel	5	Oatmeal	2
Flour	8	Prunes	2
Meal	8	Condensed milk	1 to 2
Macaroni	2.4 to 3.0	Sugar	½
Beans	4	Cheese	1 to 3
Peas	4	Coffee	0.4
Rice	2	Molasses	2 to 4
Potatoes	16 to 24	Dried fruit	1.3
Sweet potatoes	16	Oleomargarine	0.5

During the first six months of 1916 the beef furnished averaged 8½ cents per pound; corned beef, 12 cents; salt pork, 10 cents, and fresh fish, 5 cents. The following figures, taken at random from the camp records, are for the month of March, 1916, this month being about the middle of the period between the opening of the camp and the close of the government fiscal year. For this reason they may be considered as average:

Daily number of officers	7.97
Daily number of convicts	39.33
Daily Cost of Food	
For officers	$0.235
For convicts	.1714
The total cost for March, 1916, was:	
Food for officers	$63.09
Food for convicts	209.30
Total cost of food	$272.39

All purchasing for the camp is systematized and must go through regular channels, so that a constant check is kept on everything that goes into the camp and for what it is intended and used. When an article is required it is sent through on a regular county requisition by the camp clerk to the county purchasing agent at Atlanta, purchased by the latter official and forwarded to the camp. The invoice is in duplicate, and the camp clerk checks the bill, returning it to the county accounting department. It is then presented to the Board of Commissioners, which issues a warrant on the county treasurer.

Health Conditions Are Unusually Good

Health conditions at the camp for the first year of its operation have been far better than had been anticipated. There have been no deaths and no serious accidents. Only three-tenths of one per cent of the inhabitants of the camp have had to have medical attention, which is a remarkably low record, perhaps traceable to the excellent sanitary conditions. The prison physician from Atlanta visits the camp once a week, and at any other time upon call of the camp authorities. When a case has had attention, and continues to need medical care after the doctor has made his first call, the patient is sent at once to the Barracks Hospital at the county prison, remaining there until he is entirely well.

The rules of the camp require the men to bathe at least once a week in the winter, and at least twice a week in the summer, though they are allowed to bathe as much oftener as they desire. Quite a number took daily baths last summer. About 15 gal. of water per man is required for bathing, and an additional 15 gal. per man is used for washing and the preparation of food. All clothes are washed once a week at the Bellewood Barracks, where clothes from all the camps are thoroughly cleansed. A laundry truck makes the round of the camps, collecting the clothes and delivering them to the laundry, and then redistributing them to the camps. Since every piece of clothing bears the registered prison number of the owner, there is little or no confusion.

All Buildings of Special Design

There are four buildings—namely, the office, commissary, sleeping quarters and mess hall—costing approximately $1,600. Their life is estimated at seven years, and all repairs are charged to the quarters account. The sleeping quarters and the mess hall and kitchen are supplied with running water, as is also the large bath tent, which stands at the rear of the sleeping quarters. Water is secured from a well that was drilled while the camp was being constructed. In this well is an automatic compressed air pump driven by a gasoline engine.

THE GARBAGE INCINERATOR, CONSTRUCTED BY MEMBERS OF THE CAMP, IS MADE FROM STONE AND MUD

The sleeping quarters are plain, with a minimum of furniture. There is one chair beside each bed, which is a double-deck metal cot provided with a straw mattress. The sleeping quarters are well ventilated and aired weekly, and all bedding is kept clean and sanitary.

The buildings composing the camp are heated with adequate stoves in which wood is generally burned. High windows afford ample ventilation without drafts, and there is an abundance of light. A stove has also been provided in the bath tent so that there can be no excuse for not taking baths in cold weather.

A small home-made garbage incinerator, constructed of stone and mud, takes care of the dry and semi-dry wastes from all parts of the camp. The slop from the camp is traded to the farmers in the vicinity for milk and eggs, and enough of the latter are secured in this way to provide amply the requirements of the officers' mess. This slop was formerly fed to several pigs that were kept at the camp, but they were disposed of, as it was found that they attracted and bred flies.

Twelve teams of mules are generally kept at the camp—in an open shed in wet weather and in an open corral back of this shed in good weather. They are fed in the open shed or stable and watered at a stream that runs through the end of the corral. It has been found considerably cheaper to own and keep the mules than to hire them, the cost per team per day being about $1.60, which includes blacksmithing, medicine, feed and the work around the corral.

Work Done Was Mainly Heavy Grading

In the first nine months of the operation of this experimental camp, grading was completed on about 2 miles of road. This was heavy work, as more than 25,000 cu. yd. of material were excavated, of which about 25 per cent was rock. These 2 miles of road are now being top-soiled and guttered with cobbles, the latter being necessary on account of the heavy grades and danger of washouts. One mile of a side road was also graded with a road machine and 8000 cu. yd. of grading was done on another road. In addition to this work, there has also been a large amount of minor work completed, including that around the camp. The men are working at a much higher efficiency than are the men at any of the other county camps, and seem to take an interest in their work. They are frequently sent in considerable numbers as far as 4 miles away from the camp, and in every case so far have shown their appreciation of the confidence that is placed in them.

Complete cost records on the operation of the camp will soon be available, and there is no doubt that they will be of more than ordinary interest when they are given to the public and others interested, as they will be in the form of a bulletin to be issued by the Office of Public Roads and Rural Engineering.

W. Tom Winn is chairman of the County Commissioners of Fulton County and co-operated with R. F. Eastham, who was assigned by the Office of Public Roads and Rural Engineering to act as resident engineer.

Poughkeepsie Bridge Again Being Reinforced—New Floor System

Changing Present Double Track to Single Track for Cooper's E-60 Loading at Estimated Total Cost of $330,000

WORK is now under way on the reinforcing of the Poughkeepsie Bridge of the Central New England Railway over the Hudson River at Poughkeepsie, N. Y. This bridge is an important link in the New Haven system, forming one of the main gateways connecting New England with the West. The total cost of reinforcing the structure is estimated at $330,000.

The Poughkeepsie Bridge, 6767 ft. long, with 163 ft. clearance above high water, was built in 1889 and 1890, designed for a loading of two locomotives with 24,000 lb. on each main axle followed by 3000 lb. per linear foot. In 1906 and 1907 it was reinforced to carry 45,000 lb. axle loads followed by 3600 lb. per linear foot. This work was described in the Engineering Record of Aug. 18, 1906, page 178 (showing a general elevation, span lengths and how approach girders were replaced); of Nov. 9, 1907, page 502 (reconstruction of anchor piers—new eyebars and reaction girders), and in 1909, Sept. 25, page 349; Oct. 9, page 405, and Oct. 30, page 502 (changing pier 1, replacing approach spans, and details of high falsework).

Changing to Single Track

The reinforcing of the present double-track structure, with capacity corresponding approximately to Cooper's E-35 loading on each track, will consist in changing the floor system of the main bridge spans to distribute the load equally among the three trusses from a single track placed in the center. The bridge will then be operated as single track on the main structure and double track on the approaches. The approaches will be strengthened for the heavy loading by the addition of metal in the tower bents and in the approach deck spans. The reinforced main structure, operated as single track, will be capable of carrying a loading corresponding to Cooper's E-60, with two heavy engines of the Santa Fe type 2-10-2.

The work of reinforcing the bridge is planned so that there will be no interruption to traffic. It is expected that the work will be completed and the bridge ready for operation under the new loading during September, 1917. Approximately 1800 tons of new steel will be required for reinforcing the main structure, and 340 tons for the east approach and 70 tons for the west approach. The contract for the work has been let to the Strobel Steel Construction Company. The engineers in charge are Modjeski & Angier. The steel work is being manufactured by the Fort Pitt Bridge Works, Pittsburgh.

Data on Absorption Losses from Reservoirs Collected by Canadian Department

Data showing the evaporation from a free water surface have been collected at Strathmore and Lethbridge, Alta., Canada. Galvanized-iron tanks 4 ft. in diameter and 18 in. deep were set in the ground with the top from 1 to 2 ft. above the ground. Careful account was kept of the amount of water added or taken out to keep the surface at a fixed point within the tanks at approximately the same elevation as the surrounding ground. The data, published in the annual report of the Department of the Interior of Canada for the year ended March 31, 1916, are given in the following tables:

Evaporation From Free Water Surface—Strathmore, Alta., 1915

Month	Total evaporation in inches	Mean daily evaporation in inches
April	4.22	.141
May	4.73	.153
June	4.33	.143
July	6.47	.209
August	4.25	.137
September	2.27	.076
October	1.78	.059
Total	28.05	

Evaporation From Free Water Surface—Coaldale, Alta., 1915

Month	Total evaporation in inches	Mean daily evaporation in inches
April	5.68	.189
May	4.28	.138
June	2.26	.075
July	4.38	.141
August	4.97	.160
September	2.93	.098
Total	24.50	

Simple and Cantilever K-Trusses Analyzed

Part II—Formulas Derived and Influence Lines Drawn for Chord and Web Stresses and Applied to the Determination of Maximum Stresses

By C. L. WARWICK

Instructor in Civil Engineering, University of Pennsylvania, Philadelphia

[IN PART I, *which appeared in last week's issue, page* 223, *Mr. Warwick presented the complete analysis for single-span conditions, and compared the K-truss secondary system with that used in the Pettit truss. In Part II the analysis is made for a cantilever arm, and methods for the determination of maximum stress in a typical web member are described both for simple span and for cantilever arm.*—EDITOR.]

Fig. 4 shows the truss acting as a cantilever arm; the free end is at a, and the effect of the anchorage may be represented for the purpose of this discussion by horizontal reactions at N and n. The application of the foregoing analysis to the determination of chord and web stresses in a cantilever arm will now be made.

Chord Stresses—Taking section 1-1, Fig. 4, it is evident that stresses EG and eg are zero for loads at and to the right of e′. With a unit load in any position from c′ to the left, at a distance x from the free end, stress d′e′ is zero, and taking moments about e or E, there is obtained,

$$\text{horizontal component EG} = \text{horizontal component eg} = \frac{r-x}{h} \qquad (13)$$

Stress EG is tensile and stress eg compressive, and each becomes maximum when the load is at a.

With the load at d′, it has been seen that the algebraic sum of the moments about e of stress d′e′ and the load is zero. Therefore stress EG is zero, which is also evident from other considerations. Then, from $\Sigma H = 0$ at section 1-1, the horizontal components of stresses eg and d′e′ are equal, or

$$\text{horizontal component eg} = \frac{p_1}{h_1} \qquad (14)$$

The influence lines aa′cdn and aa′cden, Fig. 4 (a) and (b), may now be constructed, and require no further explanation. If the members c′E and d′e′ are parallel, line cd in Fig. 4 (b) will be horizontal.

Web Stresses—Considering e′G, take section 2-2, Fig. 4. O_1 is the moment center. Loads in any position from f′ to the right do not stress e′G. Placing a unit load in any position from c′ to the left, stress d′e′ is zero, and the tensile stress in e′G is

$$e'G = \frac{x+v}{z} \qquad (15)$$

Equation 15 applies for the unit load at e′ by substituting r for x. For the unit load at d′, the analysis leading to equation 7 may be applied; or, more simply, moments may be taken about g, the intersection of e′f′ and eg, since for this condition of loading stress EG is zero. The lever arm of e′G about g being Ph'/i $(= Pz/t)$, the following equation for tensile stress is obtained:

$$e'G = \frac{P+p_1}{P} \times \frac{t}{z} \qquad (16)$$

The influence line for stress e′G is aa′cdefn, Fig. 4 (c); d is located by prolonging ge to the vertical through d′, for since the ordinate e′e $= t/z$, d′d must equal equation 16.

The analysis for stress e′f′ is similar to that for stress e′G, and leads to the influence aa′cdefn, Fig. 4 (d). The influence line for stress f′g is aa′cdef$_1$gn, Fig. 4 (d), the ordinate ff$_1$ being equal to stress f′g from a unit load at f′ $(=i'_1/h'_1)$. The method of constructing Fig. 4 (d) is similar to that used for Fig. 2 (d). If the members e′G and f′g′ are parallel, line ef$_1$ will be horizontal.

The stresses in the verticals follow directly from those in the diagonals, as previously explained.

A complete analysis should include the effect of loads on the suspended span. This may readily be done by constructing the influence lines for such loads, which will consist of straight lines, shown in part by the lines s′a′, Fig. 4, extending from the points a′ to the intersection of the base lines na, prolonged, with a vertical through the far end of the suspended span.

DETERMINATION OF MAXIMUM STRESSES

The methods of stress analysis which have been described, although developed for a moving concentrated load of unit intensity, may obviously be applied to the determination of dead and live-load stresses by algebraic methods. For complicated truss systems, the dead-load stresses are often determined graphically by constructing a stress diagram. In the case of live-load stresses, however, which in general become maximum for different members under different conditions of loading, the use of stress diagrams is not so convenient; and the stresses are in general preferably determined either algebraically or from influence lines, or by a combination of these two methods.

Simple Span—As an illustration, let it be required to determine the maximum tension in e′G due to a concentrated load system, considering the truss to act as a simple span. Referring to the influence line, Fig. 2 (c), it is seen that the loads must extend over the portions a of the span, as shown in Fig. 5, with the heavier ones near d′ and e′. The exact position of the load system for maximum stress may be found as follows:

Referring to Fig. 5, stress e′G $= M/z$, in which M is the moment about O_1 of stresses e′f′, EG and eg at section 2-2 and the external forces to the right, namely, the reaction R_n and the floorbeam concentration at f′ $(= r_f)$. The moment of stress e′f′ about O_1 is zero. Referring to the analysis leading to equation 7, the moment about O_1 of the resultant of stresses EG and eg is equal to its horizontal component, which has the value $r_d p_1/h_1$, multiplied by OO_1. Therefore

$$M = R_n(l+v) - r_f u + r_d \frac{p_1}{h_1} \times \frac{t+P}{P} h_1 \qquad (17)$$

in which R_n, r_f and r_d have the values given in Fig. 5. To determine the condition or criterion for which M, and therefore stress e′G, will be maximum, equate dM/dx to zero:

$$\frac{dM}{dx}=\frac{W(l+v)}{l}-\frac{W_3u}{p_3}+\frac{p_1}{p_2}\times\frac{t+P}{P}\left(W_1-\frac{P_1}{p_1}W_2\right)=0$$

Solving,

$$\frac{l+v}{l}W=\frac{u}{p_3}W_3-\frac{p_1}{p_2}\times\frac{t+P}{P}\left(W_1-\frac{P_1}{p_1}W_2\right)\quad(18)$$

For maximum stress, therefore, the load system must occupy such a position that equation 18 is satisfied, which can occur only as some wheel (the critical wheel) passes d′ or e′. In Fig. 5, the critical wheel is shown at d′, which is the more favorable position for satisfying the criterion, since the influence line at that point, Fig. 2 (c), is more sharply concave downward than at e′. With the load system in position, M may be computed from equation 17; whence stress e′G = M/z.

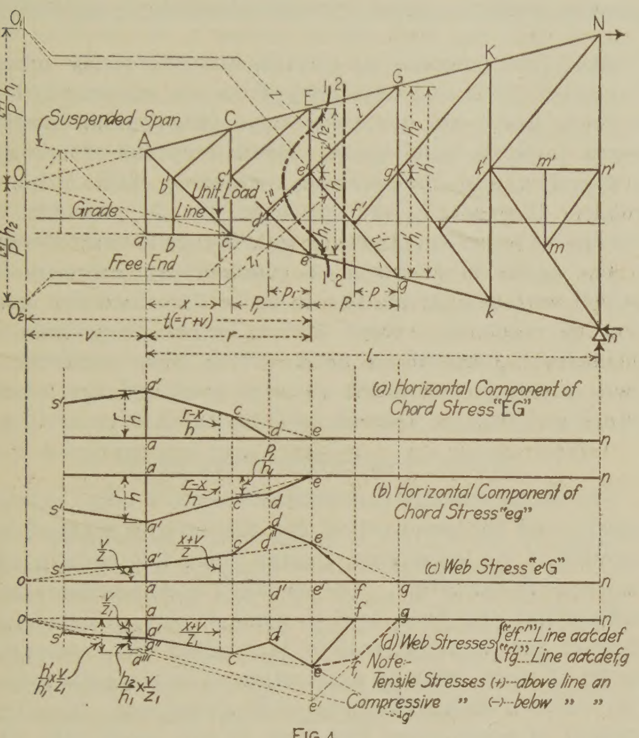

O
N
K
G
E
C
A
Suspended Span
Unit Load
Line
Grade
Free End
m′
n′
m
k
k′
g
f′
e′
d′
c′
b′
a
b
c
n
x
P
P₁
p
t(=r+v)
r
v
l
(a) Horizontal Component of Chord Stress "EG"
(b) Horizontal Component of Chord Stress "eg"
(c) Web Stress "e′G"
(d) Web Stresses {"ef" Line aa′cdef; "fg" Line aa′cdefg}
Note:- Tensile Stresses (+)--above line an
Compressive " (-)--below " "

FIG. 4
Influence Lines for Stresses—Truss Acting as Cantilever Arm

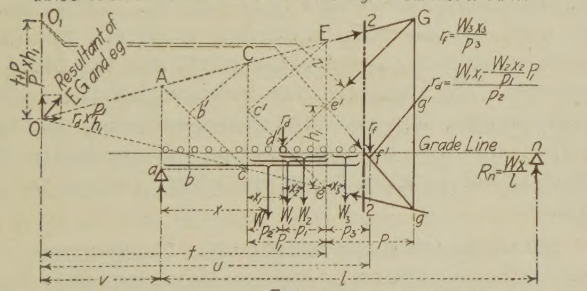


FIG. 5
Position of Concentrated Load System for Maximum Tension in e′G (Simple Span)

Or, the stress may be found by summing the products of each load by the length of the ordinate to the influence line beneath the load, such a summation being facilitated by using a rider on the scale to add the ordinates under loads of equal intensity. This method is especially convenient when the algebraic expression for stress and the criterion for maximum are complicated, as, for example, in determining the maximum compressive stress in f′g, for which the influence line, Fig. 2 (d), is relatively complicated. In that event, the position of load may be approximated with sufficient accuracy by trial.

If an equivalent uniform load is used in place of the concentrated load system, as is frequently done in long-span bridges, the conditions are simplified exactly as in the case of the usual truss analysis.

Anchor Arm—The analysis for maximum stresses in a simple span applies to an anchor arm under its own loading. Loads on the cantilever arm and suspended span cause an uplift at the anchorage, and the negative reaction developed there may be treated as a load at the end of the anchor arm acting as a cantilever arm. The stresses in the anchor arm from this condition of loading may most readily be determined by constructing a stress diagram.

Cantilever Arm—The analysis for maximum stresses in a cantilever arm is slightly different from that for a simple span. Calling the length of the suspended span l_s, the total load in that length W_s, and the distance of the center of gravity of W_s from the far support x_s, the proportion of W_s transmitted to a, Fig. 4, is W_sx_s/l_s. Then for maximum stress in e′G, for example, the following equation of moments about O_1 of stresses and external forces to the left of section 2-2 may be written, using the notation of Fig. 5:

$$M=e'G\times z=\frac{W_sx_s}{l_s}v+W(x+v)-r_fu-r_d\frac{p_1}{h_1}\times\frac{t+P}{P}h_1\quad(19)$$

Substituting the values of r_f and r_d, and equating dM/dx to zero, the criterion for maximum stress is

$$\frac{v}{l_s}W_s+W=\frac{u}{p_3}W_3+\frac{p_1}{p_2}\times\frac{t+P}{P}\left(W_1-\frac{P_1}{p_1}W_2\right)(20)$$

With the loading in position for maximum, the stress may be found by either of the methods outlined for simple spans.

35-Mile Road in Oklahoma Being Built by Convict Labor—Men Are Not Paid

Pollatalomie County, Oklahoma, the state and the U. S. Office of Public Roads and rural Engineering are co-operating in building a 35-mile road which passes through the important towns of that county. Necessary funds and a portion of the equipment are furnished by the county, the state providing the remainder of the equipment, 50 negro prisoners and four employees. The work is under the supervision of a U. S. road engineer. The National Committee on Prisons is watching the experiment with interest as a step toward affording opportunity for work to many Oklahoma convicts. The framers of the Oklahoma constitution took an advanced attitude when they inserted a provision in the constitution prohibiting the contracting of convict labor. The state has, therefore, no contract system to abolish and is in a position to forge ahead in building up its prison industries. The work is undertaken as a demonstration of what can be done with state convict labor. As no wages are paid to the convicts, cost figures are not easily available. Other states have found it practicable to pay the prisoners for their work with resulting greater efficiency.

Experiences with Standard Types of Roads Furnish Basis for Discussion

Abstracts of Papers Delivered at Fourteenth Annual Convention of American Road Builders' Association at Boston, February 5 to 9

Massachusetts Commission Relies on Asphalt, Oil and Tar

By W. R. FARRINGTON
Division Engineer, Massachusetts Highway Commission

VARIOUS bituminous materials are being used extensively on the heavier traveled roads outside the cities. The usual form of construction is a base of broken stone 3 to 5 in. thick, with a top or wearing course 2 to 3 in. thick, consisting of broken stone mixed with the bituminous material. Formerly it was customary only to use stone up to 1¼ or 1½-in. size in the wearing course, but at present the small stone is put in the lower course to get rid of it.

Sand and oil roads were first constructed in Massachusetts in 1905. As constructed with the sand usually available and without the addition of other aggregate they will not carry much heavy travel, especially if the proportion of horse-drawn vehicles is large. Experiments are being made with cement and stone dust additions, and the results indicate that some combination may be found which will result in a surface that will carry heavy travel economically.

SAND-OIL HEATING EQUIPMENT IS SIMPLE

The usual outfit for sand-oil surfacing consists of a mixer similar to a concrete mixer with charging device, and in most cases is equipped with a heating attachment and a mechanical drier. These driers are similar to the conventional drying drums, but the flame is thrown either directly into the end of the drum or into a combustion chamber at one end. The asphalt or oil asphalt is heated in kettles before mixing, and where the ordinary hot attachment is used the oil is poured into the mixer through the flame. The mixture is spread usually in one course, shaped with rakes and immediately compacted, first with a horse roller and then with a tandem steam roller. If necessary, the surface is reshaped with a road machine before the final rolling.

The best results have been obtained with oil asphalts having a penetration of from 90 to 125; but if the grains of sand are rounded or if the size of the grains varies little, as with ordinary beach sand, a very heavy oil asphalt is best. The most satisfactory results have been obtained by the use of about 16 gal. per cubic yard of loose sand. The depth of cushion should be not less than 4 in. in the center and 3½ to 4 in. at the sides. A seal coat should always be applied, using about ½ gal. of fairly heavy hot oil per square yard, with sufficient sand to take up the oil.

In constructing a road by the sand-and-oil layer method, the subgrade is shaped and the sandy places hardened. One and one-half gallons per square yard of a fairly heavy hot oil is put on in two applications, or 2 gal. in three applications. Sand is spread after each application and the surface compacted with a horse roller. If only 1½ gal. are used, it will probably be necessary to apply about ½ gal. the following season.

The methods followed in constructing bituminous-gravel surfaces are similar to those described for sand and oil mixtures, except that a larger proportion of bituminous material is used. With these surfaces a base of gravel or broken stone is used and the mixed wearing course is from 2 to 3 in. thick after rolling.

MUCH PENETRATION WORK DONE

The Massachusetts commission has, to a large extent, substituted the penetration for the mixing method on account of its lower cost, though there are certain advantages in the latter. The so-called double-penetration method has also been used to some extent. Under this method the wearing course is formed by successive layers of stone, with an application of bituminous material between each course and with a seal coat. Another method of penetration has been to mix sand with the bituminous material before it is applied. This method gives good results, but the surface is usually not quite as even as ordinary penetration work, and the first cost is greater. The results so far indicate that the surface will last longer, that resealing is not necessary so often, and that the cost of maintenance will be less. This method is not practicable except where proper sand is available.

MANY ROADS RECEIVE ONLY OIL TREATMENT

The Massachusetts commission has abandoned, generally, the heavy for the lighter grades of oils and tars for surface treatment. It is the general practice to use for the first treatment about ½ gal. of oil with a viscosity of between 40 and 50 sec. at 100 deg. C. (Lawrence viscosimeter). The second season about ⅜ gal. of oil with a viscosity of about 100 sec. should be applied, and the third season from 1/6 to ¼ gal. of a similar oil. After the second or third year, 1/6 gal. of oil with a viscosity up to 200 sec. can be used to good advantage. A combination of light and heavy oils has also been tried, the method being to form, with light oil, a thin coating thoroughly bonded to the road metal and then to apply about ¼ gal. of hot oil with a viscosity of about 600 sec.

The methods of applying and maintaining tar blankets are similar to those for oil, but tar does not take up as much sand, and hence does not form so thick a blanket. While tar does not tend to bunch as readily as oil, it requires more frequent and heavier treatments.

Earth Road Maintenance Is a Problem of Organization

By R. L. MORRISON
Professor of Highway Engineering, Agricultural and Mechanical College of Texas

IN the maintenance of earth roads, which still constitute nearly 90 per cent of our entire road mileage, the first operation should consist of shaping up the road and clearing it of organic detritus with a grader. Under ordinary conditions this should be done once or twice a year. Organic detritus not only makes a poor road surface, but it washes to the sides and hastens the growth of sod and weeds, which seriously interferes with proper drainage. In shaping up the road enough material should be moved toward the center to build up a proper crown. A steeper crown than 1 in. per foot of width forces all traffic to follow in the same track.

The proper use of a road drag is so generally understood that it should hardly be necessary to discuss it. The road drag is endowed with neither brains nor judgment, however, and if these are not possessed by the operator, good results are not to be expected. The almost pathetic sight of a split-log drag stirring up clouds of dust on a perfectly dry road is occasionally encountered. As a result local officials assert that they have tried dragging and found that it is not worth while.

GOOD ORGANIZATION A NECESSITY

The problem of maintenance is mainly one of organization, and in most parts of the United States the old system of working out road taxes is still firmly implanted. However, if the work is carefully planned ahead, the road hands called out a few at a time, and worked under experienced foremen who are continuously employed, the results are improved.

In many states contracts are made with the farmers to drag the roads near their farms at a certain rate per mile or per hour. If a county is divided into districts, the farmers can be called at the proper time and the road dragging will then interfere very little with regular work. If the district foremen are regularly employed and supplied with teams, tools, and extra helpers as required, their work, supplemented by the dragging done by the farmers, will keep the road in excellent condition at a comparatively low cost.

Another system which seems to be efficient is a part-time patrol system, under which the roads are divided into short sections and a man supplied with the proper tools is put in charge of each section. He does not devote his entire time to the care of the road, but his other employment is made secondary to the road work.

PATROL SYSTEM BEST ON GRAVEL ROADS

The gravel road probably ranks next to the earth road in total mileage. On many trunk highways a gravel surface would be entirely unsatisfactory, but on roads carrying comparatively light traffic the annual interest cost of a more substantial pavement may exceed the maintenance cost of gravel. With this type of road the regular patrol system seems to be the most economical and efficient. A small hole in a gravel road, unless immediately repaired, soon becomes a large hole. The greatest amount of maintenance work is required during the first few months after the road has been built. Before it has become thoroughly compacted and settled by traffic, the surface is likely to become badly cut up in wet weather, and to ravel in dry weather. If the gravel contains a great excess of clay it will be necessary to add a thin layer of sand-gravel free from clay. If, on the other hand, the gravel does not contain sufficient clay properly to bind the surface, a layer of clay may be added and harrowed into the gravel. Usually from 10 to 20 per cent of clay makes a satisfactory binder.

CONSTANT ATTENTION CHEAPENS MAINTENANCE

At first the scraping or dragging should be done after every rain. After the first few months a drag will be as effective as a scraper. When the surface becomes so badly worn that patching is no longer sufficient, the road must be entirely resurfaced. This work can best be done in the spring, when the road is comparatively soft. The scarifying can often be done with a heavy harrow. Before the new gravel is put on, the old surface should be well sprinkled and, if possible, rolled. It will add to the life of a gravel road to roll it every spring and after the first rains in the fall. The rolling should be done when the road is fairly soft, but not while water is standing upon it. The dragging and small repairs needed annually cost as a rule from $20 to $50, though sometimes $100 or more, per mile per year. A total annual cost of from $150 to $300 per mile should keep the roads in first-class condition perpetually; but an ordinary gravel road does not seem able to carry economically more than about 150 motor cars per day.

Monolithic Brick Pavements Preferred by Cleveland

By FRED R. WILLIAMS
Engineer of Paving, Department of Public Service, Cleveland

CLEVELAND has arrived at monolithic construction for brick pavements through experience with practically all other types that have been built. We believe that we are getting better and more durable brick pavements thereby.

The extent to which the various types were laid during the past season is indicated by the following figures:

	Miles
36 streets—natural sand foundation	4.81
13 streets—sand or slag cushion on concrete	4.02
75 streets—monolithic (cement-sand and green concrete)	10.09
Total	18.92

The monolithic types have been laid upon streets up to 28 ft. in width with entire success.

Until 1915 the sand cushion was used between the brick and base. During that year both city and county started to use the cement-sand cushion type, and following that the green-concrete foundation type. Four-inch brick have been used by the city in the green-concrete foundation type, while the county has used both 4-in. and 3-in. brick, depending on the traffic to be served. Since 1900, with few exceptions, cement grout has been used by the city and the county as the joint filler.

Uniformity in mixing the concrete is an important factor in securing the best results with the green-concrete foundation type. A quaking mix has been found most satisfactory, since this assures enough water for hydrating the cement, making it easy to handle, and at the same time provides a stable support for the brick surface during laying and rolling. In no event should so much water be used that the excess flows to the side of the street, washing with it cement and sand out of the coarse aggregate.

As yet, I have not been able to secure any lower bids for this type of construction in Cleveland than for the cement-sand bedding course type. I think this is due to the fact that contractors, wholly unfamiliar with it, bid higher than necessary to protect themselves against what they feared might prove to be a loss. I anticipate lower bids as they gain confidence and experience with the new type of construction.

Changes in Wood-Block Paving Practice Are Described

By ELLIS R. DUTTON
Assistant City Engineer, Minneapolis

IN the earliest years so-called experts said that the preservative oil for wood-paving blocks had a tendency to distribute itself through the block, and also insisted on the necessity of extracting all the resin from the wood before treatment. To accomplish this last result, steaming was resorted to. While the expected object was not attained, the practice was in itself good and is now incorporated in modern specifications for the purpose of preventing bleeding, to secure a proper distribution of moisture throughout the block and to eliminate expansion troubles traceable to the laying of dry wood.

Many Preservatives Used

For a while it was thought that the only point worth while paying attention to was the character of the oil, and all discussion turned about the selection of type. But more recently it has been proved that there are a number of oils or tars that are quite suitable for this use. In fact, the specifications adopted by the American Wood Preservers' Association permit the use of water-gas tar, which has no definite relation to creosote.

It has been claimed that the oils used about 1908 would not be stable and remain in the block. In the fall of 1916 we took up some blocks laid in 1908 and extracted the oil. On comparison with the original oil it was found that the residue above 355 deg. Fahr. was raised 3 points and the gravity was changed from 1.10 to 1.116. The blocks had lost about 4 lb. of oil per cubic foot, but there was still sufficient remaining in the timber to insure its preservation for a number of years to come. No decay was noted in the pavement.

Bleeding Traced to Bituminous Filler

Experiments have been made in Minneapolis with the so-called non-bleeding blocks, sections of pavement of this type being laid with sand and others with ordinary pitch filler. The sand-filled sections showed almost no bleeding, only a block here and there showing oil on the surface. Blocks laid with bituminous filler, however, were in quite a bad condition as far as bleeding was concerned, but it is thought that this was due to the filler. In this connection there seems to be no difference in action between pitch and asphalt filler.

Expansion joints at right-angles to the curb line have been given up. These joints were found to be a source of trouble only and served no useful purpose. The angle with the curb at which block should be laid has been the subject of certain experiments in Minneapolis in 1906. The result indicates that blocks laid at 67½ deg. and at 45 deg. show less trouble from joint wear than those laid at 90 deg. The value of one type or another of a pavement is largely economic. As to maintenance, no pavement is cheaper than wood block. It may be said that the average cost of repairs for the past 10 years has not exceeded 0.1 cent per square yard per year, and there is no question as to the wood-block pavement surpassing all others as to noiselessness and low traction resistance.

New York State Concrete-Road Practice Outlined

By H. ELTINGE BREED
First Deputy Commissioner, New York State Commission of Highways, Albany, N. Y.

THE IDEAS presented are based upon the inspection of pavements in various parts of the country, and, more validly, on the actual construction in New York State of 201 miles of second-class concrete pavement of a 1:2½:5 mix, which we have ceased using; and upon the actual construction of 364 miles of cement-concrete pavement, of a 1:1½:3 mix, built in the last four seasons.

Grades

Our original practice was not to exceed a grade of 5 per cent, but to-day we are building as high as 8 per cent under certain conditions. Grade seems to be limited only by the ability of the wet concrete to run during the process of construction, by the character of the mix and the kind of traffic expected. The use of a coarse sand prevents the road from being slippery, and brooming of the surface facilitates the traction hold of all classes of traffic. Floating should be kept at the minimum, as this operation brings the finer particles to the surface.

Most of the roads we have been building in New York State are 16 ft. in width, because the money appropriated to build our system was on the basis of approximately $13,000 per mile. Only by the strictest economy, by substituting different classes of pavement within certain limits of cost, and by federal aid can we expect to have all our important roads brought together into a good highway system. It would be far better, however, and ultimately more economical, if we had sufficient funds to build them 18 ft. in width.

Cracks Due to Foundation Settlement

Cracking of a concrete pavement is due generally to the unequal settlement of the subgrade. If the road is to be satisfactory, it is of first importance that a good subgrade be secured. These we consider the essentials of a good subgrade:

1. It must have uniform bearing power.
2. It must be dry.

3. It should have metal reinforcements (a) under very bad—unequal—soil conditions, and (b) wherever the supporting power of the subgrade changes, as from rock to earth, or passing over a trench.

Our experience indicates that the expense of reinforcement is not justified in gravelly or sandy soils where good natural drainage prevails.

AGGREGATES RECEIVE MUCH ATTENTION

The proportions of fine and coarse aggregate are varied slightly, as a result of field void tests, to obtain the greatest density. Should the size or character of the materials change, there would be a corresponding change in the proportioning of the mixture. We allow, as our maximum size, stone that will pass a 2¾-in. ring, whereas most specifications permit only 1½-in. stone as a maximum. Equally as good, if not better, results are obtained from the larger stone, and at a cost decidedly lessened by using more nearly the product of the crusher.

All sand must meet a definite grading specification, must not contain more than 5 per cent of loam or silt, must develop a compressive strength equal to standard Ottawa sand, and must be free from organic matter or any coating on the grains. There has been a far greater proportion of rejection of sand and stone than of cement.

All our men, from the engineer in charge of the road up, are instructed in all the tests and methods of inspection, and they complete them on every inspection of the work. We believe that our best results may be attributed to the esprit de corps engendered by this method.

CONCRETE IS TESTED REGULARLY

Two 6-in. test cubes are made from every 500 cu. yd. of concrete. They are cured for 21 days in moist sand and then shipped into the laboratory and tested at 28 days. The results of these tests are given to the engineers on the work and the rivalry to have the highest test value produces good results. It is expected that these cubes shall go over 3000 lb. per square inch in compression. Of 504 cubes tested in 1916 only 13¼ per cent were below specification. The causes of these deficiencies were as follows:

	PER CENT	
	1916	1915
Coarse aggregate coated	61.9	35
Fine aggregate containing an excess of loam or made up of excessively fine-grained sand	25.7	43.9
Coarse aggregate poor quality	6.2	8.2
Poor manipulation in making cubes	6.2	16.9

Policy of Road Office in Federal Aid Is Taking Shape

By L. W. PAGE

Director, Office of Public Roads and Rural Engineering, Washington

THE PASSAGE of the Federal-Aid Road Act has served to bring the federal government to the aid of the states through the working out of a great co-operative policy under which the states and the federal government share the expense of road construction.

There is an apportionment of duties and responsibilities which makes the undertaking co-operative in the fullest sense. The various provisions of the act develop a working plan thoroughly in harmony with this principle and take into account that portion of the undertaking which can best be accomplished by the states and that which can best be accomplished by the federal government. The states select the roads, make the surveys and prepare plans, specifications and estimates, and when the actual work of construction is reached, they directly supervise the work and the maintaining of the roads constructed. To the federal government falls the duty of inspection and approval, that there may be a check and balance provided and that it may be assured that the money it appropriates is properly expended.

The requirement in the Federal-Aid Road Act that the proportion of cost paid by the federal government shall in no case exceed 50 per cent should encourage self-help and discourage insidious paternalism; and it should check insistent and excessive demands upon the federal treasury, because the amount which the states will seek must be limited to the amount which they themselves are in a position to provide.

WHAT IS "SUBSTANTIAL CONSTRUCTION"?

In Section 6 of the act is a provision that the Secretary of Agriculture shall approve only such projects as may be "substantial in character." The department has been asked to announce the classes or types of construction that might be defined as substantial and as to whether grading an earth road would be included. Since there are forty-eight states with every conceivable kind of topography, climate, traffic and other governing conditions, the impossibility of making any definite decision on this point must be apparent. Each state must submit its case and convince the department that the construction which it proposes is substantial in character.

The department in approving a state program can only insist that the provisions of the act are complied with. This has particular reference to whether the routes are all "rural post roads" which are defined as "any public road over which the United States mails are now or may hereafter be transported," excluding certain streets and roads in municipalities. The U. S. Attorney General has been requested to render an opinion which will clarify this definition and establish a definite basis for the determination as to each project that may be submitted.

STATE HIGHWAY DEPARTMENTS MUST BE FIT

Some advocates of local control seem to feel that the highway department should be merely a channel through which the counties and townships may deal with the federal government, but the federal act clearly states that the highway department must be the responsible agent, technically qualified to submit suitable plans, specifications and estimates of cost to the federal government. It must directly supervise all construction done under the terms of the act, and designate the payee who is to receive federal funds. It is not necessary for the state's proportion of the cost of federal-aid roads to be paid out of state funds, nor does the direct supervision required by the act to be exercised by the state highway department involve the award of contracts by the state instead of by the county.

Many of the states leave entirely to the local units the initiative in selecting the roads on which state aid is to be applied and in applying for such aid. This must result in much piecemeal construction, very often to the detriment not merely of the state at large but of the interested localities as well. For example, suppose an important market road passes through the center of County A for a distance of 10 miles, through a corner of County B for 2 miles, and through an important section of County C for 8 miles, making a total of 20 miles. It may readily happen that counties A and C will make application to the state for aid in the construction of this very important highway, but the interest of County B is so slight that it may refuse to apply for state aid, thus leaving an important gap which will serve to defeat the whole purpose of this road construction. The power of initiative should unquestionably be vested in the state highway department.

MUCH DEPARTMENT WORK UNDER WAY

Two amendments to the regulations called for by the act have been adopted: Amendment 1, merely providing that Section 1 of Regulation 6, requiring a project agreement between the state highway department and the secretary to be executed previous to commencement of construction of project, should not apply to projects submitted prior to the issuance of the rules and regulations. Amendment 2 affects Section 8 of Regulation 5 and extends to March 31, 1917, the date within which plans, specifications and estimates may be submitted without conforming to a standard to be prescribed by the secretary.

In each of the ten established districts there is an office under the direction of an engineer. A careful examination has been made as to whether the various states have a highway department within the meaning of the act and as to whether adequate assent has been given to the terms of the act. All but a few of the states have been upheld in their claim. In a few cases it has been found necessary to suggest the advisability of securing additional legislation to broaden the powers of the highway department. A number of the highway departments have submitted their schemes or programs of work, and these schemes or programs are now receiving careful consideration. A number of individual projects have been submitted. Definite approval of them is for the most part delayed until the attorney general announces his opinion as to what constitutes a rural post road, but it is probable that the working season of 1918 will see a large number of important projects actually under way.

Traffic Census Applied to the Design of Roadways

By D. B. GOODSELL

Assistant Engineer, Department of Public Works, Borough of Manhattan, New York City

THE TRAFFIC CENSUS is too little known and used, as yet, to be of much service. Nevertheless, it has a place in the design of country roads, and has loomed up recently with a large and important aspect in great cities. In fixing the width of any roadway surface, the number of lines of traffic to be accommodated should be given consideration. The statement has been made that, where a vehicle has to turn off a hard surface of a country road on to an earth shoulder oftener than five times in a mile, it is cheaper and safer to construct the additional width of road surface which may be required.

CLEARANCE AND SPEED

The amount of clearance which a vehicle must have to pass other vehicles safely depends on the speed. At 10 miles an hour the width of a single line of auto traffic, including clearance, would be about 8 ft., and at fast speeds, 9 ft. or more. The additional clearance required by an overtaking car should be considered. When moving at, say, 25 miles an hour, at least 4 ft. of free way should be given the overtaken car, to avoid accident due to unexpected deflection from its course.

Courtesy Fifth Ave. Assoc.

FIFTH AVENUE, NEW YORK, CARRIES SIX LINES OF TRAFFIC

In the Borough of Manhattan, New York City, a realization of the necessity for widening the narrow crosstown roadways of the mercantile district and some of the north and south streets took shape in 1911, and has resulted in the widening of fourteen streets and avenues. On all of these streets a 10-hour census of the vehicular and pedestrian traffic was taken. It was found that the maximum number of vehicles per foot of width per minute should not exceed 0.5, nor the maximum number of pedestrians per foot of width per minute, 5.0.

CHARACTER OF SURFACE IMPORTANT

The influence of the percentage of horse-drawn traffic on the kind of pavement, its grade and alignment, should be given weight. Where more than 75 per cent is auto, sheet asphalt is, in the opinion of the writer, the pavement par excellence; if the traffic is evenly divided into rubber and iron tires, wood block stands out pre-eminently; while if slow-moving horse-drawn traffic amounts to more than 50 per cent of the whole, close-jointed granite blocks are eminently satisfactory.

The tractive resistance of various paving materials should, in the opinion of the writer, be given much greater weight than is usually accorded them. Auto trucks, in the cities at least, will soon be in almost universal use, and the consumption of fuel will undoubtedly be carefully examined into, and smooth surfaces demanded for economy of operation.

A few figures as to the growth of the auto truck in New York State are presented. It is estimated that auto trucks traveled over state and county highways in 1915, for 40 weeks in the year, 14,700,000 miles, and that those trucks operated 60,200,000 ton-miles.

There were in New York City in 1916 about 21,000 auto trucks, or double the number of 1914.

CENSUS HELPS SOLVE CONGESTION PROBLEM

The traffic census finds its application in the regulation of traffic in large cities where congestion is imminent or actual. The Borough of Manhattan has found it necessary to establish 29 streets as one-way traffic streets. A determination of the amount of traffic in all the streets of any section of a city should indicate where a diversion of the flow is desirable. The writer believes that such studies are highly important, to the end that alternate traffic routes may be laid out.

In the Borough of Manhattan, the Fifth Avenue Association has influenced traffic on that avenue by encouraging merchants and others to exclude commercial traffic from this distinctly retail mercantile and residential thoroughfare, so that there is now less than 2 per cent of horse-drawn vehicles of all kinds. This association makes its own traffic censuses, and studies traffic conditions quite independently of the city.

WHAT THE CENSUS SHOULD INCLUDE

The traffic census should include observations as to the direction of the flow of traffic, such as left-hand turns; number of vehicles emerging from, or entering, side streets; routes of mail trucks and other vehicles; wandering cabs, etc., as well as a knowledge of the various classes of vehicles. The points at which the count should be taken are worthy of study.

Uniformity in methods of taking and recording censuses and in the assignment of weights is much needed, for comparisons in different sections.

Experience with Road-Building Equipment Given

By **JOHN H. GORDON**
Contractor, Albany, N. Y.

THE contractor's plant and equipment represent his largest fixed investment, and upon their discriminating purchase, intelligent operation and adequate care depends in great measure his success. Scattered, as nearly every road contract is, over 5 or 10 miles of country, it is difficult for the contractor to give concentrated attention to every part of his work and to the proper use of the various large tools. Even men of experience and ability will continue with tools and methods which could be improved if proper attention were given.

Ultimate success depends first on organization and second on plant and equipment. Organization is the more important of the two, for it will be conceded that with an efficient organization results may be obtained even though the plant and equipment are not of the best. All too often, however, the contractor trusts the expensive machine, relying for results on the judgment of a man whose only qualification is being able to keep up steam.

LARGE TOOLS A CONSIDERABLE ASSET

The contractor's plant and equipment proper consist of the large and expensive tools which are carried on his books as an asset. Conservative management should mark off yearly a material depreciation, but in the lean years this is sometimes omitted, and the contractor deludes himself into thinking his resources are much greater than their actual market value.

The steam roller in general use is the 10-ton double-cylinder model. Where there is sufficient work, the 8-ton tandem roller is an excellent tool for finishing bituminous roads. The life of a roller is indefinite, but with care it will surely last ten years and more. The use of steam shovels on state-road work has been made possible in the past few years by the construction of a shovel of smaller size. Unquestionably there is a material saving in the initial cost of steam-shovel excavation over any other method. A firm with ample capital and doing a large business will find it an excellent tool, but the greatly added wear and tear on the wagons should be considered.

SELECTION OF STONE CRUSHER AND ITS SITE

The stone crushers in general use are of the jaw type, and the size favored is the one with an opening of 10 x 20 or 12 x 20 in. While there are in use some crushers of a considerably larger jaw opening, they are mounted on skids and are satisfactory where a considerable quantity of stone is to be crushed at one location. The nature of the stone to be crushed is also a material factor. The use of one jaw of manganese steel will prove a saving. As at present constructed, the gyratory crusher is suitable only for a stationary plant.

The crusher itself should be set on concrete to reduce vibration, and the approaches should be graded so as to make easy the hauling to the platform of the largest load. Constant lubrication of all parts of the crusher is an absolute necessity. The bin for tailings should be placed on the end and at right angles to the supply bins, so as to have as little interference as possible with the teams or trucks in loading. A 50-ton portable bin may be used to advantage where the output is to be approximately 3000 cu. yd., but for a larger output the 100-ton stationary bin will more than repay the additional cost.

ECONOMY OF POWER HAULING IS DEBATABLE

Most contractors are using one or more motor trucks, with or without trailers. On long hauls over improved roads their value is unquestioned, and for repair work and resurfacing they are economical. Where one truck only is possible, the 3 or 3½-ton is usually more suitable than the heavier, and can be used for more purposes. The traction engine and train is not in as general use as some years ago, but where the quarry or source of supply is a considerable distance from the road, and the connecting roads are unimproved, it is usually economical. The steam roller with not too large a load is one of the best and cheapest forms of hauling. The dump wagon should be equipped with short poles and rods, easily removable when the wagons are again to be used with teams. Many contractors are using 4 and 5-yd. wagons with tractors.

The use of the fresno is not so well understood in the East, but in the hands of an experienced man, and with teams broken into the work, it is adaptable at a great saving for much of the work of fine grading now usually done with pick and shovel. Contractors in the West are more experienced with this tool, and contracts are done profitably at half of our cost. Though the road machine is used by most road superintendents, it is difficult to find a grade foreman who has other use for it than in trimming shoulders.

The difference in cost between the spout and broom type of concrete mixer is immaterial and the results obtained are largely a personal matter. In building any small concrete work, small portable mixers will effect a great saving in labor. For curb, gutter and edging, steel forms will show a material saving, but they must be properly cared for or they will warp and bend. Special concrete wheelbarrows should always be used and will pay for themselves in a short time. Where the water has to be brought from some distance the use of a gasoline pump and piping is an economy.

Plows, whether rooter or grading, should be of the best, as they are the most economical. The points will have to be replaced, but the plow itself should last several seasons. While I do not think the costly shovel is the most economical, since the percentage of lost tools on road work is a consideration, I like the best picks, for there is a great saving in blacksmiths' bills.

Suggests Way to Get "Fat" Garbage for City Plant

As a "health" measure it has been suggested to the Cleveland City Council that the "fat" garbage from hotels and restaurants can be diverted from private reduction plants to that of the city. If it were possible to secure this garbage for the city plant, its earnings would be considerably increased. Therefore Nau, Rusk & Swearinger, certified public accountants, who have been employed not only to perform the regular duties of an accountant but also to suggest constructive criticisms of methods of administration, recommend the following plan:

The City Council could pass an ordinance authorizing it to obtain this garbage by its own garbage-collection department. Many of the wagons of private reduction plants now go through the city streets uncovered. Were the council to pass a "health" measure requiring a city inspector to accompany such garbage wagons to inspect the collection of garbage and charge a fee for the cost of inspection, it would make possible the collection by the city of the garbage from hotels and restaurants. The city collectors could be appointed as inspectors of garbage collected by the garbage department. A sanitary measure along these lines would probably have the approval of the general public. Since the city is under the necessity of dealing with the problem of garbage collection generally, it should have the advantage of rendering this service in the places where it is profitable as well as in the places where it is unprofitable.

Proposes Subway Terminal and Tubes for Cleveland

Project Is Advocated to Relieve Streets So Congested That Street-Car Efficiency Is Materially Lowered

VEHICULAR traffic in Cleveland has increased so much that former street-car headways have been materially reduced. To find out the extent of the present vehicle traffic a census was taken Jan. 20 by the city street railroad commissioner, Fielder Sanders, who gives data in a report submitted to the city council Jan. 25. In this report Mr. Sanders, as a relief measure, proposes a subway terminal and short tube approaches.

The traffic count was made on inbound and outbound traffic at the corners on the edge of the congested business district extending from Superior and West Ninth streets to St. Clair and East Ninth streets, Euclid Avenue and East Fourteenth Street, Prospect and East Fourteenth and the market or Eagle Avenue. In the 4 hours and 15 minutes 5880 automobiles and 1187 wagons passed the outside points into the congested district, Euclid Avenue and East Fourteenth Street leading with 1987 autos and 71 wagons. In the same time 7796 automobiles and 1305 wagons passed these points out of the district, Euclid Avenue and East Fourteenth Street still leading by a great margin. The totals were fairly evenly distributed over the 15-minute periods.

COUNT MADE OF STANDING VEHICLES

During the same period of time, in order to determine the constant condition of the streets, a count was also made of all standing vehicles in the same district. The results showed that 10,056 automobiles and 1236 wagons stood and were parked on the downtown streets, Ontario near the market having the most, and Prospect, Euclid and Superior being close seconds.

In addition to this, during the twelve hours from 6 a. m. to 6 p. m. 3687 street cars came into the square and went out; 1254 cars went around the four Ontario, Prospect, Second and Champlain loops and 33 cars around East Ninth Street. Between 5 and 6 p. m. 613 cars entered and the same number left the square loops at the rate of one every 30 seconds on each track. Out Euclid Avenue between 5 and 6 p. m. there are 171 cars. The street-car traffic has been so delayed by this great excess in vehicular traffic that in order to prevent tie-ups and gaps on the line it has been necessary to increase the running time on several of the lines so that the cars may remain properly spaced.

Mr. Sanders believes that the city should build a subway terminal with short tube approaches under the public square of adequate size to accommodate all the downtown lines. The cost is estimated roughly at $5,000,000. He would have the work done by the city from a municipal bond issue. As immediate steps to relieve the present conditions it is recommended that some way be devised to distribute the rush-hour evening traffic over a longer period. Advertisements, campaigns of education and agreements of merchants are mentioned. As the tracks in the square are now saturated, he suggests new tracks on the square itself or the running of cars on loops on streets outside of the square.

Making and Filing Valuation Maps—Part I

Requirements of Interstate Commerce Commission Entail Much Work, Which Should Be Carefully Organized—Will Result in Invaluable Uniform Records

By JAMES G. WISHART
Office Engineer, Chicago, Rock Island & Pacific Railway

IN CONJUNCTION with the act of Congress requiring the valuation of common carriers operating in the United States, the Interstate Commerce Commission issued in January, 1914, specifications for maps and profiles to be prepared and filed with the commission by the railway companies. This apparently innocent order has been or will be the cause of an immense expenditure of money by the railroads of the country. A vast amount of drafting work will be required, calling for the services of draftsmen experienced in railway-map drafting. It can safely be said that the act, passed at the time it was, proved a godsend for many an engineer and draftsman, opening up opportunities to earn a livelihood during an especially dull period in railroad-construction work.

This article describes a style of compiling and transpose method of filing the original tracings from which those filed with the commission are copied, of filing the office copies of the filed maps and the organization of the drafting force for carrying on the work.

REQUIREMENTS OF SPECIFICATIONS

The specifications referred to describe in detail the material, scales, symbols and lettering to be used, as well as the character and arrangement of the information to be shown, on the various classes of maps and profiles prepared for filing with the commission. Standard styles of certificates are given and specified information is required in the titles. The method of indexing is also carefully defined and the exact size of sheets is given. It does not require a very extensive study of these specifications to reveal the fact that many of the requirements, including the sizes of sheets and styles of titles, are not in common use by the railroads. The result of this is that of the maps and profiles already in the files of many of the companies but a small percentage are acceptable under the specifications, and will therefore have to be redrawn.

SIZES OF SHEETS

The size of sheets selected by the commission is 24 x 56 in. for all maps and 12 x 56 in. for profiles, with border lines the dimensions of which shall be 23 x 55 in. and 10 x 55 in. respectively. These sizes were apparently selected in order that 4 miles of right-of-way or profile on a scale of 400 ft. to the inch, or 1 mile of station land or track map on a 100-ft. scale, can be shown on a sheet. This with the maintaining of even miles on all sheets, on either scale, is the only argument, to my mind, in favor of this unwieldy and inconvenient size of sheets. It has been fixed, however, by the commission, and the railroads must make the best of it.

There are two methods of filing sheet drawings which are generally recognized as satisfactory—in a vertical file suspended singly or in folios or flat in drawers. The prescribed size of the sheets practically eliminates the drawer system, owing to the extreme length of the tracings. The modern vertical filing cases are of comparatively recent origin, and consequently have been adopted and installed in very few railroad drafting rooms. In cases where the railroad company is equipped with filing cases which are not suitable for filing on either of the foregoing systems, the question of the best and most economical method of preparing and filing the new tracings is one deserving the most thorough consideration.

The writer has been in close touch with the map and profile work in connection with the valuation on the Rock Island lines, constituting nearly 8000 miles of line, and the method of filing and sizes of sheets have been carefully studied out, not only with the idea of utilizing the old filing fixtures but also for convenience in handling. In this case it was necessary to make new tracings for more than 6000 miles of line owing to the scale being too small or to the worn condition of the old tracings, some of which were from twenty to thirty years old, so that satisfactory blueprints could not be obtained. The profiles of practically the entire system are being traced over for

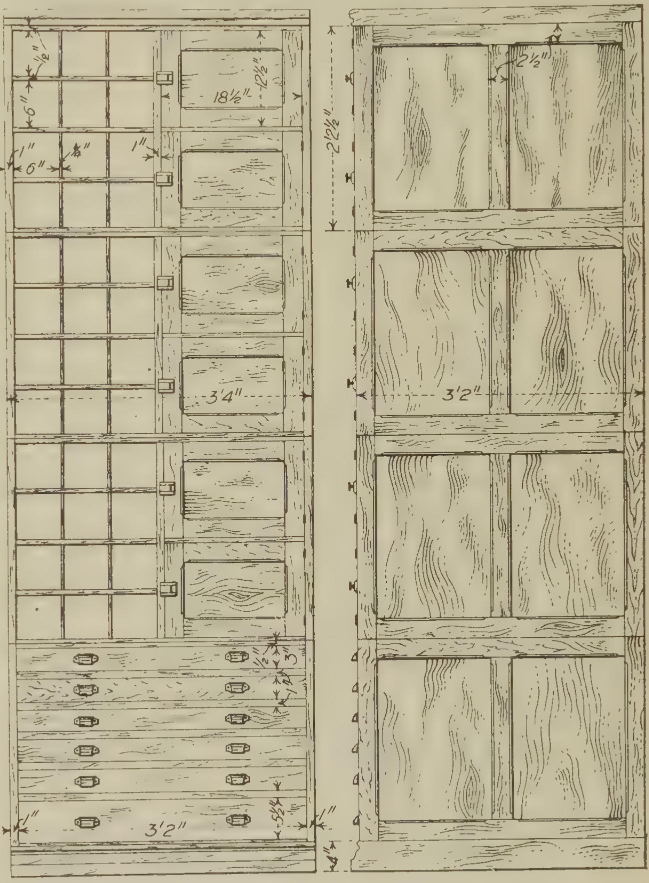


FIG. 1—DETAILS OF FILING CASE FOR MAPS

the same reasons, and approximately 1500 station plats are being replatted. In addition to these, the index maps for each valuation section and special land maps for a large number of the more important stations were made to fulfill the requirements of the specifications, these latter maps being necessary for valuation purposes only, and being unnecessary insofar as the completeness of the company records was concerned.

The filing cases were of the cabinet type, and designed for filing in rolls on or inside of tubes. These cases were built in units, each unit containing twenty-four compartments, each six compartments covered by a door. The cases are 30 in. deep and the compartments 6 in. square. The construction is as shown in Fig. 1.

The expense of replacing a portion of these cases with a vertical filing system sufficiently large enough to accommodate both the original tracings of the new maps and profiles and the office copies of those filed with the commission was one of the points in favor of the adoption of the system to be outlined. A second and more important reason for adopting this system was to overcome the objections being raised by many engineers to the 4-mile sections of maps, and especially with reference to the profiles. These objections are mainly with reference to the inconvenience of having a number of disconnected sheets to handle when looking over a long stretch of right-of-way map or profile, or a large station map. This is especially noticeable in laying grade lines on a profile, as the break in the profile seldom comes at a convenient point on the grade line, and every engineer has experienced the extra work caused by such an occurrence.

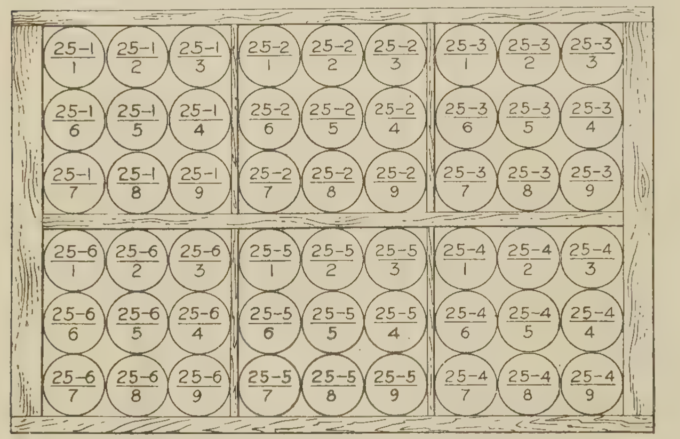


FIG. 2—SYSTEM OF NUMBERING RIGHT-OF-WAY TUBES

LONG MAP CONVENIENT FOR BLUEPRINTS

Still another item to be considered, which also favors the rolls, is that of making blueprints. Where continuous prints are required, as is usually the case, the separate sheets must be pasted together, thus causing extra labor, loss of time and waste of blueprint paper in the blueprint room. A few years ago, in the days of the small sunlight printing frames, this would not have been considered a serious objection, but the modern continuous electric blueprinting machines add to the desirability of adhering to the system of making these maps and profiles in long rolls, as the labor of making and trimming blueprints from long rolls is reduced to a minimum by the use of these machines.

For the foregoing reasons the new tracings of right-of-way maps and profiles were made in rolls long enough to accommodate an average of 25 miles. The limits of rolls were carefully worked out beforehand for the entire line, and the adopted limits are being adhered to as closely as possible in the making of the tracings. The right-of-way maps are made 30 in. wide, the alignment of the main track being placed along the roll in such a way as to minimize the number of breaks in the map.

STATION MAPS

The station maps are made from 21 to 36 in. wide, depending on the area of territory to be shown, and long enough to show all tracks and other facilities at the station and also to provide for future track extensions of ½ mile at both ends, and in addition leave an extra foot of clear tracing cloth. In the case of the larger towns it was, in some instances, necessary to make the station plat in more than one roll to avoid making too large and cumbersome a map. In such cases a maximum of about 4 miles is allowed to the roll.

The adoption of these sizes for the original tracings, however, can in no way affect the size of sheets to be filed with the Interstate Commerce Commission, which must be according to the specifications, these being made by a lithographic reproduction process, as described later. The impression has been gained to some extent that the original tracings should be made according to specification, in size as well as otherwise. This is not true, and they should be made of the most economical and convenient size.

FILE RIGHT-OF-WAY MAPS IN TUBES

For filing the right-of-way maps, four-ply cardboard tubes capped at one end are used. These tubes are 1⅞ in. in diameter and 35½ in. long. Each compartment in the filing case holds nine of these tubes, thus accommodating approximately 225 miles of maps. The tracings are rolled tight and filed inside these tubes without rubber bands or other means of fastening to keep them rolled, and the tubes are filled with the capped end out. Fig. 2 shows the typical appearance of the six compartments under one door, with the tubes in place. The six compartments have a capacity of 1350 miles, and a total of 5400 miles will go in one unit of cases.

The most satisfactory method of capping the end of the tubes is by means of a soft wood plug ⅜ in. thick, set into the end of the tube and fastened in place by four small tacks or brads, or with glue. The outside face of the plug can then be covered with paper for receiving the index number.

MAPS FILED BY STATES

Maps are filed by states, and as far as possible a state is filed complete under one door. This of course must be varied according to the total mileage and the number of branch lines in the state. All or parts of two different branch lines are never filed in one tube, regardless of their length; short lines are given separate tubes, a liberal allowance is made for future extensions on all branch lines and spare tubes are left for possible new lines. For these reasons one state will in some cases require two doors, while in other instances two states may be filed under one door. The doors are numbered and also labeled with the name of the state and the kind of maps. On the inside of the door is placed a diagram index map for right-of-way maps or profiles and an alphabetical list of station maps with their index numbers. The diagram map shown in Fig. 3 is typical of those used for right-of-way maps.

By referring to Fig. 2 it will be seen that the compartments under each door are numbered from one to six, and the tubes in each compartment from one to nine. The complete index number for a map consists of three numbers. Thus, 25–2–8 represents a map filed under door 25, compartment 2 and tube 8. The complete index number is shown on the capped end of the tube and on the outside or back at both ends of the tracings. This is done for the convenience of the file clerk, who when filing tracings away at the close of the day's work does not have to unroll them to ascertain their number. The complete index number is also shown as a part of the title on the tracing, so that it may be readily identified from prints and accurate reference may be made to it in ordering additional copies. This is especially valuable where the request is made by telegraph. It will be noted from Fig. 3 that only two figures are shown on the index diagram map, these referring to the compartment and tube respectively. The limits covered by each roll are shown plainly on the diagram by station names.

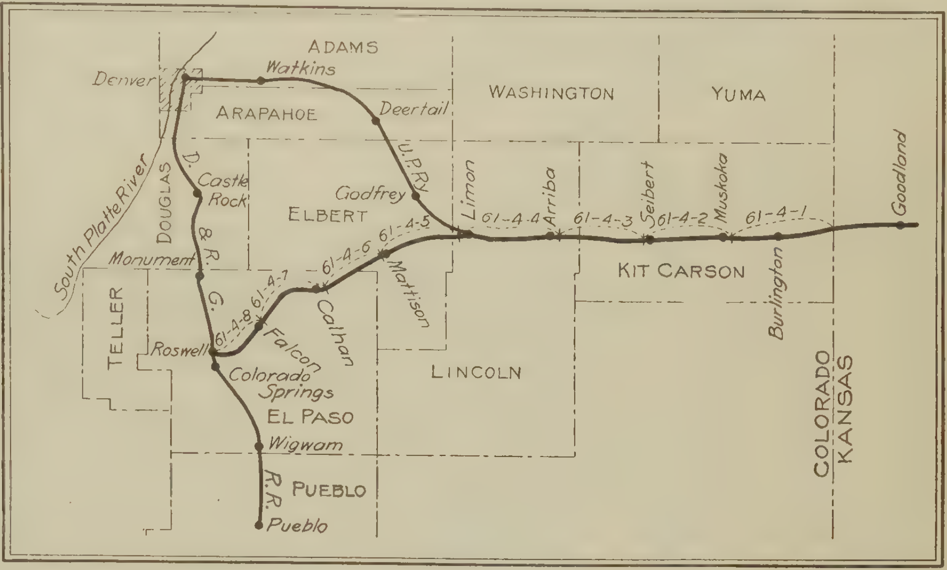


FIG. 3—DIAGRAM MAP IS PLACED ON INSIDE OF DOOR

STATION PLATS FILED OUTSIDE OF TUBES

Station plats are filed on the same system as the right-of-way maps, except that they are rolled on the outside of cardboard tubes 1 in. in diameter and 35 in. long, from fifteen to twenty being filed in a compartment. These tubes are made of four-ply cardboard, with a wood plug in each end to carry the index-number tabs and to keep the tube from crushing. To prevent the tracing from slipping off the tube a 6 x 9-in. piece of unprepared blueprint cloth is glued, as a flap, at the center of the tube, this being rolled into the tracing as it is placed on the tube.

Rolling on tubes in this manner requires the use of rubber bands as fasteners, which is objectionable. The space available in this case, however, necessitates the use of this method. The extra length of clear tracing cloth left at each end of the tracing, as mentioned above, is of special value where this method of filing is used, as it serves as a protection to the map portion and prolongs the life of the tracing fully 100 per cent. Where plenty of space is available I would recommend that the station maps be filed on the inside of tubes slightly smaller than those used for the right-of-way maps.

ROCK ISLAND LINES
PHILLIPSBURG, KANSAS.
Secs. 22, 26 & 27, T. 3 S., R. 18 W., Phillips Co.
CHIEF ENGINEER'S OFFICE, CHICAGO, ILL., APRIL 1915
SCALE: 1 INCH = 100 FEET
INCORPORATED
INDEX NUMBER 18-2-5
....LEGEND....
indicates Rock Island Tracks and Property
PLATTED FROM I. C. C. VALUATION NOTES

FIG. 4—STANDARD TITLE GIVES ESSENTIALS AND OMITS CHANGEABLE INFORMATION, SUCH AS NAME OF DIVISION

In place of the diagram map, an alphabetical list of stations with the index number of each is placed on the inside of the door. The full index number is shown on the ends of the tubes by means of round pasters. These pasters are lightly tinted in colors, tubes for No. 1 compartment in each door being left white, No. 2 being tinted green, No. 3 pink, No. 4 yellow, No. 5 blue and No. 6 brown. This color scheme enables one to see at a glance if a tube is filed out of place, also serving as an aid to the file clerk to prevent his placing the tubes in the wrong compartment. The full index number is shown on the ends of the maps in the same manner as on the right-of-way maps, and is also included in the title on the map.

The title for use on the original station maps is somewhat different from that specified for use on the reproductions to be filed with the commission, and is designed to give all important general information relative to the location of the station. Fig. 4 presents a typical standard station map title.

[TO BE CONCLUDED]

Allopathy Versus Homeopathy

The average road builder is continually striving to improve the drainage of his roads, and to keep water away from them, whereas in a dry climate the endeavor is to keep them damp. In Utah, after attempting without success to keep gravel roads in good condition by sprinkling them with watering carts, an experiment is now being made with more drastic methods, the road being drenched instead of sprinkled.

Recent Tendencies in Concrete Construction

Abstracts of Some Papers Presented at the Thirteenth Annual Convention of the American Concrete Institute, Held in Chicago, February 8 to 10

Proportion of New Concrete Industrial Buildings Growing

By W. P. ANDERSON
President, Ferro-Concrete Construction Company, Cincinnati

AS A RESULT of an investigation made by the author to establish something specific regarding the tendency toward concrete construction for industrial buildings, it appears that this type of construction has made great strides since 1905; while other types have by comparison stood still.

The investigation, undertaken during the past year, covered the collection of data regarding the floor area, type and material of industrial buildings erected during the period from 1905 to 1915 and part of 1916, within what may be roughly classified as the middle states. When inquiry was begun, the writer was unaware of the Portland Cement Association's efforts—later characterized by its chief engineer as "unavailing"—to secure similar statistics. In spite of the difficulties experienced by the Portland Cement Association in its effort to collect data on this subject, the investigation, which had been begun by sending blanks to a selected list of manufacturers in various fields, was continued. The more important industries covered by the inquiry were those of manufacturing metal goods, textiles, paper, leather, boots and shoes, and brewing. Information was also obtained from many other industries too diverse to be classified. More than 1300 replies were received, many of which indicated that no building had been undertaken within the years specified, or gave no information. On the other hand, many of the replies included several buildings.

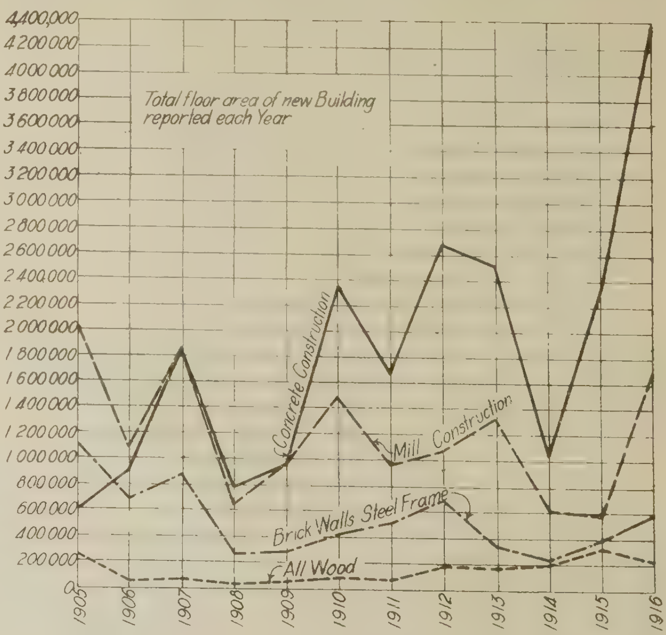
DATA FOR TABLES

The data from which the table and the diagram were prepared were furnished by 370 concerns and cover 1230 buildings varying greatly in size, use and construction, but all employed for industrial purposes. In many cases the returns indicated construction features which made it difficult to classify the buildings under any of the headings given on the original date sheet, which are those indicated on the diagram. For instance, numerous buildings were reported as "brick walls, mill construction," but with steel frame, while others were specified merely as having brick walls and steel frame, sometimes with wood floors, sometimes with concrete and usually without statement as to the character of the roof. This was noticeable in the case of one-story buildings. However, the chances of improper grouping were generally eliminated by careful analysis of the returns and amplification of the classifications to the nine headings of all wood, concrete throughout, concrete with steel frame, brick walls with concrete floors, brick walls with steel frame and concrete floors, brick mill construction, brick walls with joist floors, brick walls with steel frame, and miscellaneous.

Such diversified grouping manifestly reduced to a comparatively small number the buildings which fall within each subdivision. The figures for buildings completed during 1916, moreover, cover a somewhat uncertain period of 6 to 8 months, the reports having been made during the late summer. These reports are particularly impressive when compared with those for previous full-year periods. In preparing the curves and the table, the total for 1916 has been taken as 50 per cent more than the reported total. This estimate is thought to be conservative, as the period reported manifestly averaged less than 8 months.

FOUR GROUPS OF DESIGN

For purposes of comparison, so far as the general character of the construction is concerned, it is obviously justifiable to combine the reports as at first listed under the nine headings given above into four comprehensive groups designated as all-wood, mill construction concrete construction, and brick walls with steel frame. Grouped in this way, the returns shown in the table and the diagram give the totals for each year of the entire period. The first three divisions are reasonably definite, but the fourth division, which is believed to include many one-story buildings, leaves a doubt regarding the material of the roof and floor. The unclassified buildings listed as "miscellaneous" have been omitted.

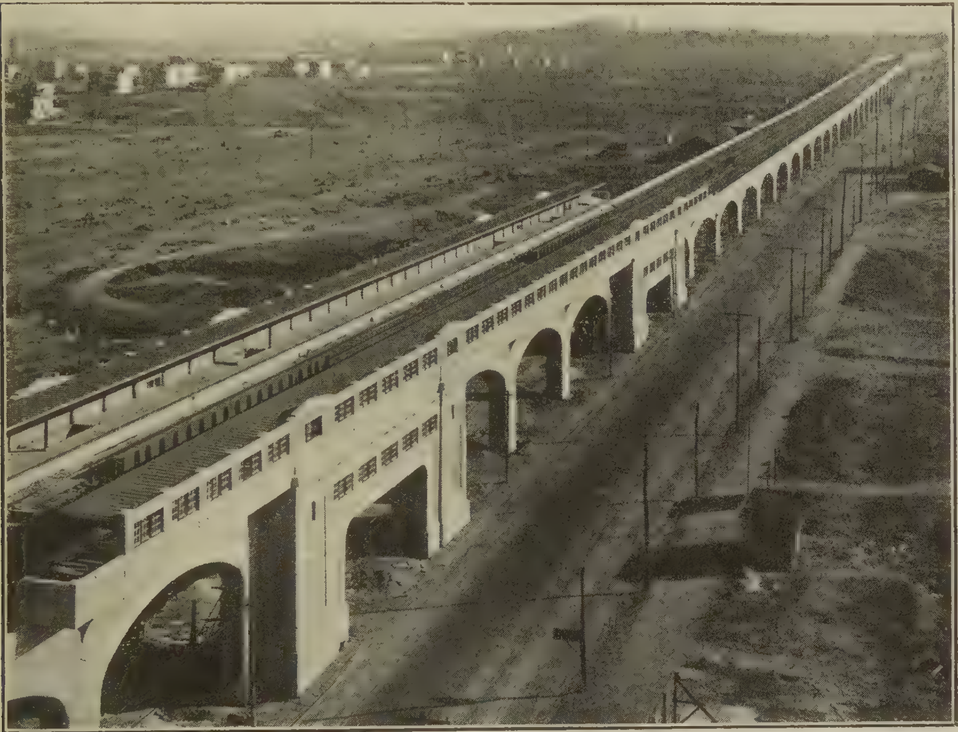


CONCRETE CONSTRUCTION SHOWS GREAT GAINS DURING PRESENT INDUSTRIAL EXPANSION

FLOOR AREAS OF FOUR PRINCIPAL TYPES OF CONSTRUCTION OF NEW BUILDINGS REPORTED FOR EACH YEAR, 1905 TO 1916

Year	All wood	Mill construction	Concrete construction	Brick walls, steel frame
1905..........	262,137	2,470,425	617,739	1,117,723
1906..........	59,700	1,092,566	901,940	700,326
1907..........	65,372	1,840,754	1,868,769	895,189
1908..........	31,954	658,232	789,741	271,532
1909..........	52,808	952,241	974,390	282,427
1910..........	95,332	1,468,990	2,358,067	434,495
1911..........	63,691	958,250	1,660,243	513,363
1912..........	182,308	1,061,828	2,658,554	684,547
1913..........	166,091	1,329,329	2,500,121	341,013
1914..........	200,235	612,338	1,010,153	214,984
1915..........	323,667	572,949	2,375,039	491,958
1916..........	225,081	1,705,785	4,363,975	585,521
Total.......	1,728,376	14,723,687	22,078,731	6,533,078

Of course the abnormal disturbances during the last three years account for the great fluctuations within that time. Yet even up to and including 1913 the advance of concrete construction in relation to the other types is distinctly noticeable. Although for a single year in 1913 concrete dropped while mill construction increased, the former type exceeded the latter by 88 per cent, while in 1916 the excess amounted to 156 per cent. The comparative growth of concrete construction is more plainly brought out, however, by comparing the periods of 1905 to 1910 and 1911 to 1916. In the former, the returns cover 7,014,218 sq. ft. of mill construction and only 5,152,579 sq. ft. of concrete construction. In the latter period, on the other hand, the area of concrete construction jumped 329 per cent to 16,926,152 sq. ft., while mill construction showed a bare increase of 10 per cent to 7,709,469 sq. ft.



QUEENS BOULEVARD ELEVATED—RAWSON STREET STATION IN THE FOREGROUND

Area of Colt's Building Overstated

The figure of 2.8 acres net floor area for the Colt's building, completed to schedule by the Aberthaw Construction Company and described in the Engineering Record for Feb. 3, 1917, page 186, was intended to apply to the entire building, and not to one floor, as stated.

How Concrete Ornamental Elevated Stations Should Be Treated

By S. J. VICKERS

Designing Architect, Public Service Commission, New York City

FOLLOWING the policy of the Public Service Commission of the First District, New York, special treatment has been developed to beautify elevated stations constructed near parks or in important streets in New York City as part of the dual system of rapid transit. These stations, for the most part, are steel structures incased in concrete. The new work ties in with the present Rapid Transit System, giving over 600 miles of single track with a carrying capacity of 3,000,000,000 passengers per annum, and will cost $350,000,000.

The first specifications of the commission called for concrete of special mix on all outer or exposed surfaces, to be kept from the ordinary concrete by steel shields placed about 2 in. from the outer faces. This method was, however, never used, as it was found that by using Long Island gravel, which contains some dark stones which give variety, and by properly dressing the surface excellent results could be obtained. The shields and special mix were given up, thereby avoiding considerable structural difficulty.

In pouring the concrete care was taken to obtain a uniform mix and work it tightly down against all faces of the forms. Even when extraordinary care is used, certain imperfections will appear after the removal of the forms. In certain places it was necessary to cut these imperfections out to a considerable depth and fill with a 1:2:4 concrete, the same as the original mix. No dressing was done to the concrete until after it had set at least a month, as it was desired to chip the gravel to give the surface a bright and sparkling appearance. The dressing was done with pneumatic machines, four-pointed tools being used on the greater part of the surfaces, but in certain large fields where a rough surface was desired the bull-point or one-pointed tool was used.

The inside of the forms was given a coat of cheap lubricating oil prepared especially for this purpose. In certain work we were able to have the forms removed within a week; on other work, such as the reinforced-concrete viaduct, it was necessary to keep them in place until the concrete was thoroughly set.

The contractors were required to dress away any unevenness caused by the bulging of the forms, bringing the surfaces to even planes, in which all the cement skin was removed and the gravel lying near the surfaces was chipped or cracked to give a sparkling effect. By the removal of a considerable portion of the surface most of the board marks disappeared. It is a curious fact, however, that a few board marks will remain although the entire surface is dressed to a plane, caused probably by the fine sediment collecting about the joints of the boards.

COLORED TILE IN DOMED ARCH CONSTRUCTION

The most unusual piece of construction is the reinforced-concrete structure for Queens Boulevard in the Borough of Queens (see the Engineering Record of Aug. 26, 1916, page 254). A continuous band of colored tile with a plaque on each column was inserted to add color to the gray concrete surface. About 20,000 sq. ft. of tile was used on this piece of construction—probably the largest tile contract of its kind. The tile, selected with great care after considerable investigation, is wet-pressed, hand-made, semi-vitreous, and glazed, with scores of dovetales on the back to insure a perfect bond with the concrete.

Inlaid colored tile is most appropriate as an enrichment for concrete structures. It is not unusual to see concrete structures built in imitation of stone, with cornices, modillions, dentals, string courses, rustications, keystones—all of which may only be done with expensive formwork. How much better to design simply, striving for big surfaces which may be enriched but unbroken by well-placed and well-designed tile.

There is perhaps an analogy in literature to the rich color spots set in the rough exterior "like a rich jewel in an Ethiope's ear." The neglected, raging Lear enters, bearing Cordelia in his arms. "Ha!" we hear him say, "Her voice was ever soft, gentle and low, an excellent thing in woman." We turn from harsh Shylock, who "rather threatened than did promise aught" to Antonio, to listen to the fair and gracious speech of Portia: "The quality of mercy is not strained, but falleth like the gentle dew of heaven upon the earth beneath."

As the great dramatist by way of contrast tempers with pathos the speech of his rougher characters by a gracious word or introduces the melody of a woman's voice, so the designer arranges spots or bands of color in the unyielded surface. In designing concrete, therefore, omit meaningless forms, however appropriate they may be in other materials, and strive rather for large and simple surfaces dressed to a uniform texture, enriched but unbroken.

MOSHOLU PARKWAY STATION ON JEROME AVENUE LINE ERECTED OVER EXISTING BRIDGE

Should Be Better Relations Between Engineers and Contractors

By C. A. CRANE
Secretary, General Contractors' Association, New York City

ENGINEERS in charge of construction work—the buyers for the public—can effect an enormous saving in other ways than by perfecting economical designs. One of these ways is in perfecting an up-to-date form of contract eliminating the present one-sided and unfair clauses, and including clauses that put a premium on enterprise and good management—"inducement clauses," they might be called—which would attract the many reputable contractors who at present either will not bid on public work or, when they do so, bid extravagantly high. The American Institute of Architects did that very thing a few years ago, and its "standard contract documents" are in universal use on private construction. Whatever benefit accrues to the owner of structures built under this form of contract is due in large measure to the builders, through whose persistent efforts the documents were brought to the present state of perfection.

Do not forget that the owner pays. A pertinent paragraph quoted from a pamphlet issued by the National Association of Builders' Exchanges in a campaign to secure the forms in architects' contracts brings out this point:

"It may be inferred that it is only for the benefit of the contractors that a reform is demanded. The fact should not be lost sight of that the contractor is not the ultimate consumer in the case and that he generally will protect himself from such conditions by a sufficient allowance in his price; it is the owner who must eventually bear the burden."

GOOD ADMINISTRATION REDUCES COST

Unfair clauses, ambiguity in specifications or quantities, lack of inducement—all combine to pile up the cost of work. The personal equation of the engineer, too, is taken into consideration by the contractor in preparing his bid. A prominent contractor, who has built hundreds of miles of the most difficult railroad sections in the country, was speaking of this point just a few days ago. He mentioned two of the big railroad systems which are not many miles apart, saying that when the A., B. & C. road wanted bids he went after the work hard and bid to get it. But when the X., Y. & Z. railroad let a contract he didn't care whether he got it or not. If he did take the work, his bid was 20 to 40 per cent higher than on the A., B. & C. The engineer on the X., Y. & Z. had the reputation among contractors of being the meanest, most arbitrary and hard-to-suit customer in the country. It cost that road millions of dollars more, said this contractor, to get its work done than was paid by the neighboring road, and for years to come it will pay dearly for the reputation of its chief engineer.

Delays in Engineering Work Expensive

Inducements do not mean a letting down of the bars and a free invitation for every Tom, Dick and Harry to come in and run the job to suit himself. On the other hand, inducements are referred to that will be an incentive to good and rapid work—inducements that will not only benefit the contractor but accrue as well to the benefit of the public. For example, suppose the contractor can finish ahead of time, is it advisable for the owner to delay him and make him maintain his plant and force when he could be using them to advantage elsewhere? On one of the large aqueduct tunnels in New York the contract time was 48 months. By good management and improved methods the contractor completed 95 per cent of the work in 26 months. The remaining 5 per cent of the work consisted of the installation of some metal work to be furnished by the city and the placing of some concrete after the metal was in place. The metal was not delivered for 18 months after the contractor was ready to receive it.

In the meantime the contractor had to keep his plant in place, maintain watchmen, pumps and a force to look after the plant, keep his bond in force and lose the interest on the retained percentage, amounting to half a million dollars, in addition to sundry other losses. Eventually he finished the job just within contract time. The only satisfaction he could get was sympathy. Everybody was sorry, but his work wasn't supposed to be done so quickly.

Inconvenience to Public

The public paid in this instance, not in increased cost of the work but in inconvenience. The contract extended through the busiest part of the city, and shaft structures and unavoidable street obstructions, maintained an unnecessary length of time, all constituted an injury to business impossible to reckon in dollars and cents.

On subway contracts now building in New York the contractors complain that their working plans have been delayed for months after they were ready for them, thus retarding their progress. It has been asserted that the serious accidents which occurred in two sections undoubtedly would not have taken place had the steel been erected. On those particular sections the steel plans had been delivered to the contractor only shortly before the accidents and nearly two years after the contracts had been awarded. Those accidents cost the contractors some money—and the public paid, too, but their loss was not reducible to money damage.

Contractors for big work assume a big responsibility for the lives of their workmen and for the lives and property of the public. With this and the financial responsibility incident to the work itself it would seem that the contractor assumes enough without taking on responsibility for acts of the Almighty. Take, for instance, the construction by the government of the compensating dams along waterways that are especially susceptible to floods. The government contracts generally call for a temporary cofferdam to be used in the construction of the work. The contract provides for payment for one cofferdam. If it is washed away, it must be replaced at the contractor's expense, and all other damage caused by the floods must be borne by the contractor.

Because of the inherent gamble in this class of work there are not many contractors in the country anxious to bid, and such as do, make very careful studies of average weather conditions, taking a gambler's chance on them. If the conditions subsequently are more favorable than the average, the contractor makes a handsome profit. If they are worse, as in the case of some recent work on the Ohio River, where eleven heavy floods, some reaching a stage of more than 40 ft. above normal, occurred within a period when not more than one or two floods were to be expected, the contractor loses heavily.

Paying for Possible Floods

It is unfair to the government to have to pay more for the bulk of its work than its reasonable value, and it is certainly unfair to the contractors to have to lose hundreds of thousands of dollars on some of the work through agencies beyond their control. If these contracts should provide a method of payment for flood damage, the government would not be paying a big contingent overhead when there were no floods, and when serious floods occurred the contractor would be reimbursed merely for his loss. Instead of army engineers regarding contractors who do government work as enemies to the flag, they might with profit to the country give some study to a more equitable form of contract.

In pleasing contrast to these contracts under the War Department is the attitude of the engineers of the Navy Department, who are now engaged in just such a study, and as evidence of their announced desire to draft a mutually satisfactory document have invited criticisms of the present forms from contractors and builders, with their suggestions for improvement. This betokens a spirit that, if followed by the engineering profession generally, would go a long way toward bettering the relations between engineers and contractors.

Co-operation Cheapens Work

There is too often, however, the woeful lack of co-operation between engineers and contractors, and this is especially true of engineers of public work. The public's interest is nobody's interest, and work lags and drags in a manner totally absent from construction for railroads or other private utility corporations. One of the most intricate and stupendous pieces of work in connection with the dual subway system in New York was the third tracking of the elevated railroads. This was a $15,000,000 job, and it was completed in less than two years. The work was designed and done under the supervision of the engineers of the Interborough system and has been in operation for a year, while the men are still in some of the trenches under city supervision which were started long before the third tracking was begun.

Is it not an engineering duty to reduce this high cost of public work? Some of it—a great deal of it—is caused by too drastic contracts. A great deal more of it is due to delay in proceeding with the work, all of which the contractor anticipates and charges for in his bid. Offer inducements to the contractor to complete his work ahead of time, and the saving, if only in the less inconvenience to the public, will be enormous.

Contractor's Costs Valueless Unless Used by Entire Organization

By LESLIE N. ALLEN
Aberthaw Construction Company, Boston

A SYSTEM of cost accounting, to be of any value to a contractor, must be accessible to and made full use of by everyone in his organization who has anything to do with costs. It is valueless if kept a secret. A proper system of cost accounting, like an expensive machine, is of great worth when working, but an unjustifiable expense if kept idle. The contractor who thinks that his unit costs are a trade secret, the circulation of information regarding which will do him irreparable injury, is making a great mistake. If his costs are higher than his competitors' are, these competitors will lose business if they use them. If his costs are lower, competitors who use them will lose money. It is efficiency, not cost data, that makes for lost costs. The cost data simply point a way to efficiency and show the failures to reach it. For this reason the writer's firm has not hesitated to make public its costs at any time. If this firm makes lower costs than its competitors it is because the firm has the men and the brains needed to do it. Others cannot equal these costs simply because they know them. On the other hand, if these costs are higher than they should be, no one gets any valuable information out of their publication that can give them an advantage.

EMPLOYEES' INTEREST STIMULATED

The concealment of cost data is one of the reasons why it is so difficult to get accurate results. No employee can take intelligent interest in work which is meaningless to him. Many contractors have the labor costs distributed by a timekeeper, who sends them in to the office to be worked up by the bookkeeper in his spare time, the results being seen only by the boss. Neither man understands his work or can show any enthusiasm for it. Neither cares very much whether it is right or wrong, provided that it will "get by." On the work at the writer's firm the situation is exactly the opposite. It is sometimes quite embarrassing to the writer to be called upon to adjudicate in cases where knotty points are being discussed with great earnestness by our timekeepers and foremen, such as whether repairing forms damaged by the strippers should be charged to stripping, erecting or making. The fact that such interest is shown in minor points indicates a real interest in efficient work and low costs all down the line.

The contractor who is not prepared to make his costs open and accessible is almost as well off without any cost system at all. He is certainly not getting half the return out of it that he should. The contractor's problem in any system of cost accounting is not so to conceal the costs that no one but the boss can get them or understand them, but to make the costs accessible and intelligible to the greatest possible number of people in his organization.

COST DATA CONVERT OWNER TO CONTRACTOR'S WAY OF HANDLING WORK

It is also very desirable that the architect or engineer should have some idea as to the cost of the work which is being done by the contractor under his direction. Many cases have occurred in the experience of the writer's company in which the engineer's knowledge of what the work was costing has led him to allow modifications in the design which save a good deal of money for the clients. If the cost accounts had been concealed, suggestions and arguments regarding a change in the design would have gone unheeded.

On a recent job where the depth of column footings varied owing to bad ground, the engineer desired to build all footings the same thickness and start all columns at the same height, making up the difference in depth between top of footing and bottom of column by a pyramid of concrete, each one of which of course would need separate forms of varying shapes. Instead of arguing on a matter of opinion, we were able after building two or three to demonstrate as a matter of fact that this method was much more expensive than to put additional concrete into the footings, and we were allowed to make the change.

FIVE ESSENTIAL FEATURES OF COST SYSTEM

The first essential feature of a contractor's cost system is the estimate, made for each job and based on the costs of earlier jobs of a similar nature. This estimate should show, first, the quantities, unit costs and total costs of each item of labor, and, second, the quantities and estimated prices of each item of material and each subcontract. The second feature is a daily labor cost report showing the labor costs of each day's work. The third essential feature of such a system is a weekly labor-cost report showing in parallel columns the estimated and actual quantities, unit costs and total costs of the work performed. The fourth feature is a monthly statement of the cost of the materials and subcontracts purchased or ordered, showing in parallel columns estimated and actual costs. The fifth is a final summary made at the close of the job showing the total cost of all labor and material.

The methods used by different contractors to secure such data may vary, but the use made of them should be along the lines outlined below, if the information is to be made really valuable.

ESTIMATE OF USE TO ENTIRE ORGANIZATION

In many offices the estimate is locked up in the safe the day the contract is signed and never sees the light again. The estimate is, or should be, the result of the estimator's study of cost data on preceding jobs, and is therefore the standard set for the cost of the job for which it was made. It should be made in sufficient detail to show in separate items various kinds and classes of work done by different gangs.

The estimate is of use, first, to the general superintendent as a standard of performance by which he can measure the job superintendents and foremen and as a help in organizing and carrying on the work. It is useful, second, to the job superintendent, who needs to see it more than any one. It tells him what he is expected to accomplish.

The estimate is also essential to the purchasing agent, giving him a list of all the items that he has to take care of. From it he prepares a more detailed schedule, and by taking dates from a progress schedule makes up for his own use a list showing all materials required and the dates on which they are needed in order. This enables him to buy intelligently and see that everything is delivered on time. It gives him a valuable check on the bids received, which is especially useful when it happens to be impossible to get more than one or two bidders on an item.

The foremen of the mason, carpenter, concrete and all other gangs should be told what the estimated cost of their work is and should be shown from week to week how their work compares with this cost.

Daily Labor Reports of Use Chiefly on the Job

Daily labor reports are best prepared on the job, and with a good system reports for the day previous should be in the hands of the superintendent by 9 o'clock in the morning. If each foreman is told what is the estimated cost of the operations he is performing and notified every day as to whether he is keeping within or overrunning this cost, it is sure to have its effect. The writer's company frequently plots the principal items on a chart which is posted where not only the foremen but the workmen can see it as they check in and out. The workmen take a cheerful and enthusiastic interest in the vagaries of the wandering line that shows the cost of the work they are doing. If the work is large enough to allow of gangs competing on similar work, such charts are even more valuable.

Costs to be of any use should be fresh and not stale. If the superintendent knows at 9 o'clock the next day that concrete costs 20 cents a yard more to put in than on the preceding day, he can talk it over with his foremen while the matter is fresh and investigate and remedy the fault. If the news does not come to him for a week or ten days after the work in question is done, however, it is too late to do anything. It is not necessary to have these daily cost reports go through the main office in any case, as they come in too often and contain too great a mass of detail to be of much benefit to the general superintendent. Although the job superintendent is usually able to detect inefficient or expensive work by his own experience or observation, these daily costs will point out an occasional high spot that he has missed. They are an unfailing barometer on the job.

Weekly Labor Report for Main Office

The weekly labor report should show in parallel columns the estimated and actual quantities, unit costs, total costs and saving or overrun. The amount of detail may vary in different organizations, but should be sufficient to give an intelligent account of the operations. This statement should go to the officers of the company as well as to the job superintendents, but for the benefit of the former it should be summarized in a very few items so that the status of the job can be determined at a glance without a lot of study. This statement, which gives a review of the job's operations to date, should also go to the estimator, who needs it to keep abreast of fluctuations in costs.

Monthly Report for Materials

The monthly report should show the estimated and actual costs and quantities of the materials, and the amounts of subcontracts and other expenses incurred. It is not necessary to have a weekly statement of these expenditures, because differences between estimated and actual costs are not due to the way in which the contract is being managed but to errors of judgment in estimating, unexpected rises or falls in the market, lack of information as to local costs and such factors. It is necessary, however, that at least once a month track should be kept of the amounts gained or lost on the estimate.

By adding together the savings or overruns on the labor and materials, the contractor can tell every month just how far behind or ahead of the estimate each job is, and can make an intelligent forecast as to how much can be saved or will be lost on the remainder of the job. Such information is rarely to be found in a contractor's office, but is worth alone almost all the time and expense that could be put in on a cost accounting system.

This statement should, of course, go to the general superintendent and to the job superintendent who are using the materials, to the purchasing agent who spends the money, and finally to the estimator, who finds it a most valuable check on his work.

Final Estimate Useful on Future Work

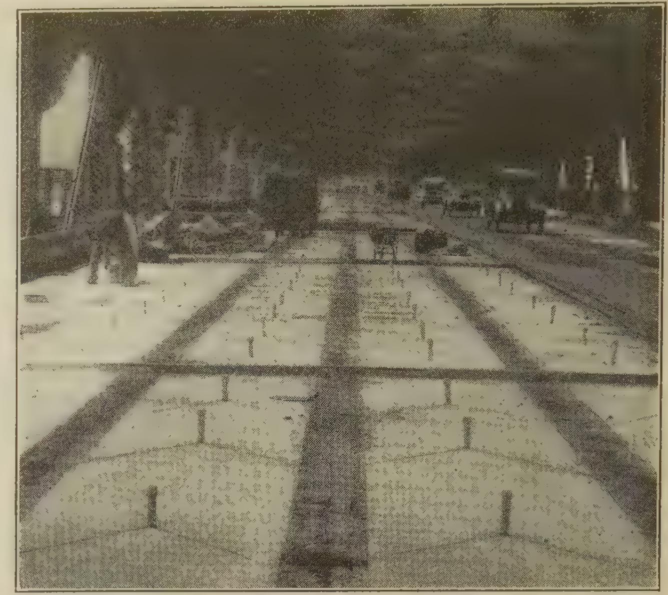
The final summary of job costs should be made up in the same form as the original estimate and filed for future use. A copy should be given to the job superintendent as a record of what he has accomplished and to the general superintendent as a permanent reference and guide for future jobs. The estimator should, of course, receive a copy, as the final estimates furnish his chief authority for prices used in new estimates.

Road Materials Tested Free

The proper use of the testing facilities which the State of Texas furnishes without charge to its road builders is described in a statement recently issued by P. Nash, testing engineer of the Texas Bureau of Economic Geology. Before any road work is undertaken, he says, a thorough search should be made for all deposits of road materials in the district. Samples of these should be sent to the bureau for testing, and the reports will show what are the best materials. The roads which will best meet the traffic requirements can then be planned, possibly using local material exclusively and possibly with material shipped in by rail. In this way the taxpayers will receive the maximum returns for their money. The plan is precisely that recently advocated by the president of the New York Road Contractors' Association as the fairest for the highway contractors.

Stiffened Floor Insures Smooth Pavement on Queensboro Bridge

Depressions and Ridges in Original Wood Block Surfacing Were Caused by Deflections of Buckle-Plate Supports and Heaving



REMODELED FLOOR READY TO RECEIVE WOOD BLOCK

Note transverse Z-bars to prevent creeping, thimbles in drainage channels through buckle-plates and concrete base, and longitudinal timbers over stringers.

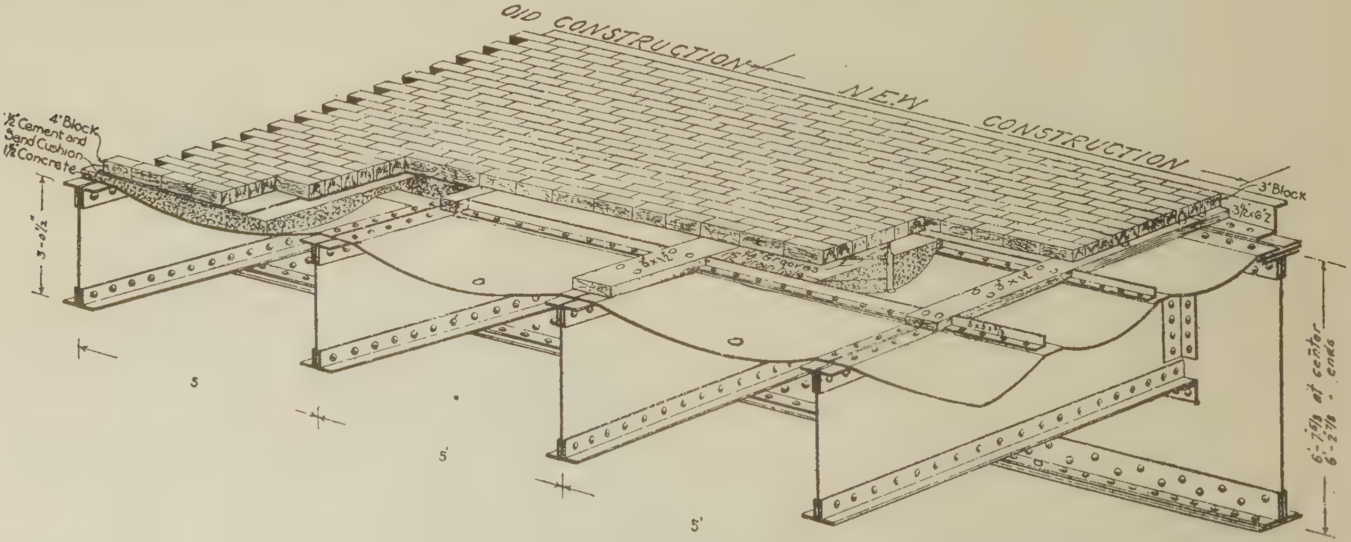
BY stiffening the buckle-plates which carry the roadway of the Queensboro Bridge over the East River, New York City, replacing the old 1:3:6 concrete base with a richer mix, providing facilities for the drainage of surface water, and eliminating the sand-cement cushion which supported the original 4-in. creosoted wood block pavement, it has been possible to maintain a smooth surface in place of the ridges and depressions which racked the frames of passing vehicles and made traffic across the bridge a perilous venture. The remodelled floor system, the result of study and experiment by Edward A. Byrne, acting chief engineer of the Department of Plant and Structures, not only insures a paved surface which will not heave, creep or sink in spots, but actually lightens the dead load on the bridge 780 lb. per linear foot. To date, the new paving on the southerly half of the structure has been finished and the work on the northerly half will be begun this spring. Creosoted wood block is used as the new surfacing, but the depth of block has been reduced from 4 to 3 in.

WHAT THE REPAIRS INVOLVE

The repairs involve, also, the placing of a new curb and the removal of two lines of street railway track from the roadway proper to brackets on the sides of the bridge structure. With a length of 7448 ft. 8½ in. and a roadway width of 52 ft. 3 in., the Queensboro Bridge presents a problem involving the maintenance of 43,240 sq. yd. of wood block pavement. Since the bridge was opened on March 31, 1909, traffic has increased enormously. Statistics indicate that the daily average for 1909 was 1170, while the daily average for December, 1916, had risen to 9858 vehicles passing in both directions.

The pavement foundation, as originally constructed, rested on different bases at various sections of the bridge. On one approach the base was of reinforced-concrete, which in turn supported waterproofing protected by common brick on which the 6-in. pavement foundation was laid. On the other approach the concrete foundation, 6 in. thick, rested both on earth fill and on buckle-plate floor. On the main bridge buckle-plates support the concrete foundation. The pavement laid on reinforced-concrete and on earth fill, amounting to 8640 sq. yd., has not required any repair from the time the roadway was opened for traffic in 1909. The part laid on buckle-plates, 34,600 sq. yd., has, according to Mr. Byrne, been a source of constant trouble during the past four years.

In the original construction of the Queensboro Bridge floor, the buckle-plates were carried, buckle down, by stringers spaced on 5-ft. centers. On this floor the 1:3:6 Portland cement concrete base, varying in thickness from 1½ to 4½ in., was laid. A cushion of dry cement and sand, ½ in. in depth, was spread upon the concrete base and creosoted wood block, 4 in. deep, were



COMPARISON OF OLD AND NEW CONSTRUCTION OF QUEENSBORO BRIDGE FLOOR

In the new design, at the right, it will be noted that the buckle-plates are stiffened by angle irons and that timbers are bolted to the tops of the stringers, forming basins in which concrete is deposited. Note drainage hole through concrete. In new work no cushion is interposed between paving blocks and concrete base.

laid upon the cushioned floor at right angles to the center line of the bridge. The joints between blocks were spaced ⅛ in. and were filled with a bituminous filler free from coal tar and its products.

BUCKLE-PLATES DEFLECT

During the first two years of service this pavement required only slight attention, but under constantly increasing traffic the buckle-plates deflected, resulting in the cracking of the lean concrete base. Over the rigid base provided by the stringers, however, the concrete stood up fairly well. It is quite remarkable, according to Mr. Byrne, to see how the pavement has formed a series of well-defined ridges and valleys over the entire length of the bridge where the buckle-plate type of construction was used. The ridges occur over the stringers and depressions over the buckle-plates. They vary from ¾ to 3 in. in depth.

The sand and cement cushion also is said to have been a source of trouble. This cushion never set up hard. There was no provision for draining it, and after storms it became thoroughly saturated. Under these conditions, when a sudden change of temperature occurred, the blocks heaved to heights as great as 3 ft. above the normal surface of the pavement. Then, too, the fact that the cushion failed to do its part in creating a monolithic type of construction formed a shifting base for the blocks so that, with the expansion and contraction of the bridge, the movement of the pavement was further accelerated. On several occasions vehicular traffic over the bridge had to be confined to the spaces occupied by the trolley tracks in order to avoid accident.

FLOOR SUPPORT MADE RIGID

Inasmuch as the trouble was due, not to defects in the wood block, but to the instability of the base, the problem of reconstruction resolved itself into creating a rigid floor support without increasing the dead load on the bridge. The main features of the revised design are shown in the accompanying isometric drawing. The buckle-plates are reinforced with 3 x 3 x ⅜-in. angles riveted to the unsupported fillets of the plates. Drainage holes in the buckle-plate inverts were punched at the time plates were fabricated. The new base consists essentially of a parquet foundation, formed by a combination of timber planking and Portland cement concrete, with the creosoted wood blocks laid directly on the foundation, without a cushion. On the main bridge yellow pine timber, 14 in. wide and varying in thickness from 2½ to 4½ in. was bolted to each line of stringers by machine bolts spaced 27 in. apart. The heads of the bolts were finished flush with the top of the planks and the countersunk holes around the heads were filled with Portland cement mortar. Portland cement concrete, mixed in proportions of 1:2:4 was laid in the space between the planks and finished flush with the tops of the longitudinal planks. Before concreting began, however, galvanized iron thimbles were inserted in the holes in the buckle-plate inverts so as to form a channel for the passage of water. As a further aid to drainage, diagonal grooves about ¼ in. deep and 1¼ in. wide were cast in the top surface of the concrete foundation.

HOW THE STEEL BUCKLE PLATES WERE PREPARED TO RECEIVE ANGLE IRON STIFFENERS

RIDGES AND DEPRESSIONS IN ROADWAY SURFACE WERE FREQUENT BEFORE FLOOR WAS STRENGTHENED

BLOCKS LAID WITHOUT CUSHION

In the new work the cement-sand cushion was eliminated and the 3-in. creosoted wood block were laid directly upon the concrete. The joints were filled with sand, as this material proved to be satisfactory and cheap.

In the reconstruction the longitudinal movement of the wood blocks, which was very noticeable in the old pavement, has been checked by the installation of transverse Z-bars at every alternate floor beam. The pavement, therefore, is divided longitudinally into panels from 45 to 80 ft. long, with a rigid support at either end.

The new design of floor and pavement has justified itself, according to Mr. Byrne. Certain sections have been in service over two years and have exhibited no tendency toward heaving or sinking because of insufficient floor rigidity. The Department of Plant and

Structures reports that it is standing up well under the heavy traffic which is increasing at a rapid rate.

Bridge Load Lightened

Not only has the department relaid pavement and reinforced the roadway floor of the bridge, but it has replaced loose and defective rivets which were found when the old pavement was removed and has replaced bolts by rivets where rivets should have originally been driven in the buckle-plate floor. It has also designed a new curb on the portions of the bridge over the river channels. The redesign of the curb and the new design of the pavement lighten the dead load on the bridge 780 lb. per linear foot. This reduction in weight practically equals the added materials that are being installed for the Second Avenue elevated railroad over the bridge. It is estimated that 130,000 rivets must be driven to complete the work.

An innovation in work of this magnitude is the use of departmental employees for all operations in connection with strengthening the floor system and laying the pavement. The department, under the direction of Commissioner F. J. H. Kracke, purposes to commence the removal of the northerly half of the old roadway next March, if the weather permits. During the winter months the drilling of the holes for the steel angles required in the stiffening of the buckle-plate floor will be continued. With operations thus expedited, it is expected that the roadway pavement will be entirely relaid by next June.

Sprayer Found Superior to Brush for Painting Concrete

Uniform Surface Free from Splotches and Streaks Can Be Readily Produced by Small Hand-Operated Machine

By R. C. HARDMAN
Balboa Heights, Canal Zone

A SURFACE FINISH on concrete far superior to that obtained by the usual method of brushing has been secured by the writer with a small hand-operated paint-spraying machine.

The machine consists of a small hand pump which draws the spraying material from a bucket or barrel, a short hose and a spraying nozzle through which the pump discharges the material. The apparatus is intended primarily for use with cold-water paints, but handles the heavier cement wash without difficulty.

The surface is rubbed with carborundum bricks, or prepared by some other method giving a smooth finish, before the paint is applied. The proper consistency of the material is determined by weather conditions and the kind of surface to be covered. Sand, commonly used in brush coating, should not be used in the mixture. Three men are required for the operation of spraying—one for mixing, one for pumping and another for handling the hose. With this method a much larger surface may be covered by the same number of men than by hand brushing. The surface produced by spraying is of an even, granular appearance, with uniform color, and remarkably free from the streaks and splotches often produced by brushing.

Co-operation of Municipalities Found to Be Practicable

Sewer and Water Problems Can Be Simplified in Urban Communities by Following Metropolitan District Idea, Says Morris Knowles

THE ORGANIZATION of urban communities into metropolitan districts is now regarded both practical and economical in the solution of many of their public-works problems. This, in brief, is the purport of a recent address on "The Metropolitan District Idea," given before the Washington Engineers' Society by Morris Knowles, consulting engineer, of Pittsburgh. Mr. Knowles, who is consulting engineer of the Essex Border Utilities Commission, created by the Ontario parliament for the purpose of forming the seven border municipalities on the Detroit River into a metropolitan district, outlined the operation of the districts at London, Boston and elsewhere. The address was considered of special local interest because of the discussions which have arisen for such a district for Washington and vicinity, looking to comprehensive water-supply and sewage-disposal systems.

Community Co-operation

"The need of community co-operation," said Mr. Knowles, "has grown more and more urgent with the growth in concentration of population and with the development of conditions in the Western Hemisphere which have long been prevalent in Europe. Many municipal problems are in no wise limited to the artificial political boundaries, and in many such cases efficiency and economy are secured by central control. Such improvements as water supply, drainage, sewerage, main thoroughfares, park developments and general planning are accomplished much better under united action, and thus haphazard development may be avoided."

Statistics indicate, Mr. Knowles pointed out, that districts surrounding large cities are growing more rapidly than and have problems equally complicated as those within the adjacent urban territory. It is also true that 25 per cent of the population of the United States lives within twenty-five metropolitan districts, which are subdivided into 170 municipal units, each having a population of more than 5000. Therefore the necessity for continuity and commonness of action is apparent. A great benefit that united action will give to the community at large is the prevention of injury to certain urban units, as has frequently been the result when other units, located in the same metropolitan district's area, have treated their problems independently.

Successful Illustrations

The plan has proved successful in the past, said Mr. Knowles, especially in Europe, where until recently the system has been more applicable due to the greater density of the population. Greater London, comprising 530 square miles under the control of the Metropolitan Water Board and containing two cities, thirty-five boroughs, fifty-eight districts and more than thirty-five poor-law unions and parishes, is a typical example. On the North American continent the most important illustration is that of the Boston Metropolitan Districts in Massachusetts. Here the Metropolitan Park Commission has broad administrative powers over parks and open spaces in the districts of thirteen cities and twenty-six towns surrounding Massachusetts Bay, while the Metropolitan and Sewerage Board has control of the sewerage and drainage of twelve cities and eleven towns covering an area of 190 square miles, with a population of more than 1,000,000, and of the water supply of nine cities and nine towns included within an area of 175 square miles, with a population of 1,250,000. More recently the Metropolitan Fire-Prevention Commission has been organized, having jurisdiction over twenty-two cities and towns, with extensive powers, duties and regulations relative to fire protection and prevention, and the study of fire hazards.

Mr. Knowles pointed out the likelihood of certain disadvantages of the metropolitan-district idea, such as the occasional lack of complete representation or the apparent development of works ahead of the immediate requirements. However, true community planning, although considering the future in a careful manner, will provide for the building only so fast as is really needed. In matters pertaining to assessments it is desirable that the methods shall not specify too definitely the legislative regulation, as much more satisfactory results can be worked out after the details of the project have been largely determined.

In conclusion, Mr. Knowles stated that it is always possible in any case to work out a method which will be equitable and will give service to each community involved, and that the cost of combined action is far below the sum necessary to treat the problems independently.

Literature

For the Civil Engineer and Contractor

New Publications

A Manual of Field Astronomy. By Andrew H. Holt, instructor in civil engineering, College of Applied Science, State University of Iowa. Flexible leather, 4 x 6½ in.; 128 pages; illustrated. New York, John Wiley & Sons, Inc.; London, Chapman & Hall, Ltd. $1.25 net.

Selling Your Services. Cloth, 6 x 9 in.; 176 pages. New York, The Sales Service Company. $1 net.

Tests on Corrugated Metal Culverts. Technology Experiment Station Bulletin, University of Maine. Paper, 6 x 9 in.; 15 pages; illustrated. Orono, Maine, University Press.

A Treatise on Concrete—Plain and Reinforced. By Frederick W. Taylor, M.E., Sc.D., and Sanford E. Thompson, S.B. Third edition. Cloth, 6 x 9 in.; 885 pages; illustrated. New York, John Wiley & Sons, Inc.; London, Chapman & Hall, Ltd. $5 net.

Classified List of Searches Made in the Library of the American Society of Civil Engineers from January, 1901, to November, 1916. Paper, 6 x 9 in.; 23 pages. Reprint from *Transactions*, Volume 80. New York, American Society of Civil Engineers.

Pipe and the Public Welfare. By R. C. McWane. Cloth, 5 x 7½ in.; 165 pages; illustrated. New York, The Stirling Press.

Practical Street Construction—Planning Streets and Designing and Constructing the Details of Street Surface, Subsurface and Supersurface Structures. Reprinted from the *Municipal Journal*, 1916. Cloth, 6 x 9 in.: 248 pages; illustrated. New York. Municipal Journal and Engineer.

Gypsum in Southern Part of the Big Horn Mountains, Wyoming.—Bulletin 640-H, U. S. Geological Survey. Paper, 6 x 9 in.; 18 pages; illustrated. Washington, Government Printing Office.

Gold, Silver and Copper in Alaska in 1915. Mines Report I:8. U. S. Geological Survey. Paper, 6 x 9 in.; 12 pages. Washington, Government Printing Office.

Gold, Silver, Copper, Lead and Zinc in California and Oregon in 1915. Mines Report I:10, U. S. Geological Survey. Paper, 6 x 9 in.; 50 pages. Washington, Government Printing Office.

Gold, Silver, Copper and Lead in South Dakota and Wyoming in 1915. Mines Report I:13, U. S. Geological Survey. Paper, 6 x 9 in.; 14 pages. Washington, Government Printing Office.

Iron Ore, Pig Iron and Steel in 1915. Report I:12, U. S. Geological Survey. Paper, 6 x 9 in.; 63 pages; illustrated. Washington, Government Printing Office.

Water-Supply Papers, U. S. Geological Survey. Paper, 6 x 9 in.; illustrated. Washington, Government Printing Office.

Surface Water Supply of the United States, 1914. Part 1—North Atlantic Slope Drainage Basins. Paper No. 381, 195 pages; Part 2—South Atlantic and Eastern Gulf of Mexico Basins. Paper No. 328, 66 pages; Part 12—North Pacific Drainage Basins; B, Snake River Basin. Paper No. 393, 248 pages.

Artesian Water for Irrigation in Little Bitterfoot Valley, Montana. Paper No. 400-B, 28 pages.

Measurement of Silt-Laden Streams. Paper No. 400-C, 12 pages.

Accuracy of Stream-Flow Data. Paper No. 400-D, 7 pages.

Surface Subsidence in Illinois Resulting from Coal Mining. By Lewis E. Young. Bulletin 17, State Geological Survey. Paper, 6 x 9 in.; 112 pages; illustrated. Urbana, Ill., State Geological Survey, University of Illinois.

Spirit Leveling in Texas—1896 to 1915 Inclusive. Bulletin 637, U. S. Geological Survey. Paper, 6 x 9 in.; 254 pages. Washington, Government Printing Office.

Spirit Leveling in Mississippi—1901 to 1915 Inclusive. Bulletin 639, U. S. Geological Survey. Paper, 6 x 9 in.; 80 pages. Washington, Government Printing Office.

Spirit Leveling in South Dakota—1896 to 1915 Inclusive. Bulletin 643, U. S. Geological Survey. Paper, 6 x 9 in.; 100 pages. Washington, Government Printing Office.

Spirit Leveling in North Carolina—1896 to 1914 Inclusive. Bulletin 646, U. S. Geological Survey. Paper, 6 x 9 in.; 71 pages. Washington, Government Printing Office.

Handbook of Engineering Mathematics. By Walter E. Wynne, B.E., and William Spraragen, B.E. Limp leather, 4¼ x 6¾ in.; 220 pages; illustrated. New York, D. Van Nostrand Company, $2 net.

Investigations of Gravel for Road Surfacing. By T. R. Agg. Bulletin 45, Engineering Experiment Station, Iowa State College. Paper, 6 x 9 in.; 32 pages; illustrated. Ames, Iowa, Engineering Experiment Station, Iowa State College of Agriculture and Mechanic Arts.

U. S. Government Specification for Portland Cement. Circular 33, U. S. Bureau of Standards. Paper, 7 x 10 in.; 43 pages; illustrated. Washington, Government Printing Office.

Manufacturing Costs and Accounts. By A. Hamilton Church. Cloth, 6 x 9 in.; 452 pages; illustrated. New York, McGraw-Hill Book Company Inc.; London, Hill Publishing Company, Ltd. $5 net.

Calculus. By H. W. March, Ph.D., and H. C. Wolff, Ph.D., assistant professors of mathematics, University of Wisconsin. Modern Mathematical Texts, edited by Charles S. Slichter, Cloth, 5 x 7½ in.; 360 pages; illustrated. New York, McGraw-Hill Book Company, Inc.; London, Hill Publishing Company, Ltd. $2 net.

Books Reviewed

English and Engineering

A volume of essays for English classes in engineering schools. Edited by Frank Aydelotte, professor of English in the Massachusetts Institute of Technology. Cloth, 390 + xix pages. New York, McGraw-Hill Book Company, Inc. $1.50.

An admirable collection of essays, this, with a breadth and keenness of selection that certifies the right of its compiler to occupy the chair of English in one of our greatest engineering schools. Also a most commendable introduction whose ideas are unassailable and remarkably illustrated.

The author is frankly conscious that his work is designed for the teaching of writing to the technical student. In no sense can it be taken as a handbook. It needs the attrition of the class to make its somewhat hidden gold to glisten. To any except those who know writing and its methods, the collection of essays would prove a bewilderment. For there is to be found such variant examples of style as that of Stephenson, who so sharpens the edge of each phrase that no effort is required for insertion, and that of the blustering Carlyle, desirous of no more than weight behind his hammer face. And, too, Arnold Bennett, with "pure" literature's desire to create mood in mind, might lead awry unless more than the indicated emphasis were placed upon "An idea exists in proportion as it is expressed; it exists when it is expressed, and not before."

But to balance these, Cardinal Newman's discourse makes clear that "Thought and speech are unseparable from each other. Matter and expression are parts of one—style is a thinking out into language." Also J. L. Harrington in his "Value of English to the Technical Man" draws the inescapable conclusion that the engineer who cannot speak and write English with clarity and facility is one whose thinking is clouded to the same degree—that he is an uneducated man whose every utterance casts a doubt upon all else that he claims to possess.

But a quotation from the introduction is the fullest explanation of Professor Aydelotte's endeavor, and an index of the pedagogic value of his work: "To train the student to write by first training him to think—to stimulate his thought by directing his attention to problems of his own profession and of his own education and to the illumination of them which he can find in literature: these two tasks may be performed together—better together than separately—and with that double aim in view this collection has been made."

Modern Underpinning—Development, Methods and Typical Examples

Author, Lazarus White, C.E., and Edmund A. Prentis, Jr., E.M. Cloth, 6 x 9 in.; 94 pages; illustrated. New York, John Wiley & Sons, Inc.; London, Chapman & Hall, Ltd. $1.50 net.

Undoubtedly wonderful advances have been made in the matter of supporting buildings and other structures while adjacent work is carried on which would endanger their security. From the crude methods of 15 years ago, when the usual procedure was to tear up the sidewalk and support the building with rows of timber pushers, to the underpinning methods used in constructing the William Street Subway in New York is a far cry. The old methods invariably damaged the building and interfered with its light and use, while the modern methods are carried on entirely out of sight of tenants and the public, and have been so successful that building after building, weighing many hundreds of tons and ranging up to 21 stories in height, has been underpinned in the course of the construction of the dual subway system in New York City without the slightest accident, and even without settlement.

The authors of this book desired to give the engineering profession, by brief descriptions of general methods and specific cases, and by a series of unusually clear illustrations, an accurate record of some of the best solutions of underpinning problems worked out in New York City. While the space devoted to the subject in this book is not sufficient to permit of covering the many diverse methods originated to meet various conditions, it can be said that the methods described are among the most valuable and most commonly used, and that the presentation is sufficiently detailed and clear to give a contractor or engineer who has never employed such methods a good idea of how best to do the work.

Tabulated Data Relating to Flow of Water Through Pipes

Author, George T. Prince, C.E. Flexible leather, 4½ x 6½ in.; 149 pages; illustrated. New York, D. Van Nostrand Company. $2 net.

Reviewed by W. E. Fuller
Consulting Engineer, New York City

This book is largely one of tables, showing the results of the author's computations on the flow of water in pipe by using the formulas of Kutter, D'Arcy, Lampe, Fanning, and the exponential formula $H_f=mV^{1.73}$. The discharge of pipes from 4 in. to 120 in. diameter, with varying slopes, is given, as well as the velocity in feet per second, and the corresponding value of *c* of the Chezy formula.

The author gives his views on the flow of water in pipe, discussing these formulas, together with some others. He also describes the general method of logarithmic plotting. There seems to be little new data on the subject included in the volume, nor has the author made full use of the large amount of experimental data which are available.

The book would be useful to any one wishing a comparison of the above-mentioned formulas with the assumed values of the coefficients which the author has taken.

A Manual of Field Astronomy

Author, Andrew H. Holt, instructor in civil engineering, College of Applied Science, State University of Iowa. Flexible leather, 4 x 6½ in.; 128 pages; illustrated. New York, John Wiley & Sons, Inc.; London, Chapman & Hall, Ltd. $1.25 net.

This textbook for use in civil engineering courses bases its principal claim upon conciseness, and yet completeness, in its treatment of fundamentals. On the whole, the object of the author has been obtained, and practising engineers who only occasionally have to make astronomical observations will find it especially helpful. The treatment of the ofttimes confusing conceptions of the measurement of time is given particular attention, with many illustrative problems solved in excellent form.

In fact, this text has arranged for practical use the already well-known methods found in other sources, which is all that the author claims for it. The illustrations and diagrams are clear and well-conceived, the method of presenting the successive operations is logical and the sample field notes show just how best to avoid confusion and error in the important matter of records. For use with ordinary field instruments there are presented in detail three methods of observation for latitude, five methods for azimuth determination and two methods of observation for time. The main text occupies about 76 pages, the appendices on spherical trigonometry and solar attachments for transits about 14 pages, tables about 12 pages, and the sample field notes 20 pages. The typographical work is good.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Large Concrete Tank Built Up by Plastering Mortar on Reinforcing Mesh

By CHARLES S. KAISER

Kaiser & Miller, North Bend, Ore.

USING successive layers of cement mortar to which 10 per cent of hydrated lime had been added, applied direct to the reinforcing mesh, the writer's company recently built a 17,000-gal. concrete tank without employing any forms for the walls. The floor of the tank is made of 1:2:4 concrete to which 6 per cent of hydrated lime had been added. For the walls, a cement mortar composed of sand running from coarse to fine, mixed with Portland cement, to which 10 per cent of hydrated lime had been added, in the proportion of 1 to 2½, and containing a sufficient quantity of cattle hair, was used. This was applied in successive layers to the reinforcing mesh, which was first erected and supported by 2 x 4-in. studs 14 ft. high. For the lower 8 ft. No. 42 triangle mesh was used and for the remaining height No. 27 triangle mesh. This was wired to the studs, placed outside it. On top of the mesh No. 24 gage Herringbone metal lath was laid horizontally. The motar was applied in thin coats, each of which was scratched as soon as it had set sufficiently. This process was continued until a thickness of 2½ in. had been built up on the inside of the tank. The last coat was floated, the final wash being applied with a brush consisting of neat cement and hydrated lime.

JIM SMITH, he worked a new idea—a che-ild of his mind—in swinging of a pony truss or something of the kind.

HIS FRIEND Bill Jones, he saw it done, and told it to Ed Brown, who mentioned it months later to a man from out of town.

NOW THAT MAN ran a big bridge shop, we'd like to have you know; he looked up Jim and roped him in, and Jim began to grow.

HE'S THE "OLD MAN" NOW, and in his line they say he's quite a factor.

AN ACCIDENT? Yes—then. But now we've

HINTS FOR THE CONTRACTOR.

The outside studs were then removed and mortar applied outside the reinforcing in the same way to a total thickness of 4 in. at the bottom of the tank and 2½ in. at the top. The tank, which has now been in service almost a year, is quite watertight.

The construction method outlined was originated by the writer's firm, which also designed the tank described.

Crane Pulls Over Concrete Piers

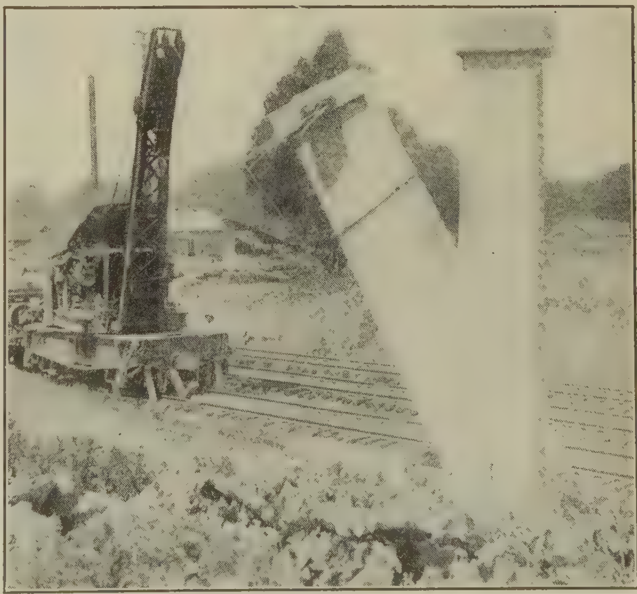
By R. T. BROWN

Engineer, Board of Road Commissioners of Davidson County, Lexington, N. C.

IN ORDER to remove some abandoned concrete piers, a pair of which are shown in the photograph, without running the risk of blocking their tracks or damaging overhead wires, the Southern Railway pulled them over with a wrecking crane. These piers were connected in pairs by short concrete girders at the top, both piers and girders being reinforced with ¾-in. steel bars. The piers rested on spread concrete bases buried under a considerable depth of earth. They were built with the intention of constructing a bridge to eliminate a grade crossing, but objections by property owners to the construction of the large fills necessary to reach the grade of the bridge defeated the completion of the project. As the piers were in the line of the highway and obstructed the view of approaching trains from the road, it was decided to remove them.

Wrecking them with dynamite was suggested, but the plan was not carried out for fear of their falling on the tracks and blocking train service. At the suggestion of a section foreman, it was finally decided to pull them over. The railroad company furnished a work train and equipment for this purpose, the engineer and several laborers being provided by the county.

An attempt was made first to pull over one pair of piers together, felling them away from the tracks, by running a line from the crane to the pier through a heavy snatch block fastened to a large tree. The only result was to straighten out the heavy hook on the snatch block, which sailed away like a clay pigeon and cut a large hole in the tender tank of the work train locomotive. It was then decided to break the girders and pull one pier at a time. A hole was drilled in each girder and loaded with about four sticks of dynamite, sacks filled with sawdust being placed over each shot to avoid breaking signal and telegraph wires about 5 ft. above each pair of piers. Not a wire was injured by either shot.



PIERS BROKEN APART AND PULLED DOWN BY CRANE

As soon as the girders were broken, the crane easily pulled one pier at a time. They were loaded on a flat car, hauled away and dumped over the side of the high embankment.

It took only little more than half a day to remove these four piers in this way, saving the time that would have been necessary to break the concrete up into small pieces and haul it away in wagons. Moreover, the work was done without danger of blocking the railway tracks. The piers were removed under the supervision of P. H. Lynch, roadmaster, and C. A. Sides, wrecking foreman for the Southern Railway, and of the writer, highway engineer for the county.

"Hydraulic" Bucket Hoist Raises Slag for Building Roof

A "HYDRAULIC" hoist in which the water power was applied by filling and emptying one of two buckets balanced on a rope passing over a pair of well wheels on a frame at the top of the building was used with economy to hoist roofing slag during the construction of a reinforced-concrete building at Keene, N. H., and is described by A. P. Rounds in a recent issue of *Concrete.*

The well wheels were attached to a light wood frame overhanging the edge of the roof and 10 ft. above it. The rope passing over the wheels, to each end of which was attached a 2½-cu. ft. wood bucket, was of such length that when one bucket was on the ground the other would be about 3 ft. above the roof. The bucket used for the slag was weighted so that it would descend to the ground when both buckets were emptied. As soon as the bucket on the ground was filled with slag, the bucket at the top would be filled with water, causing it to drop and raise the slag, which would be stopped at the proper height by the water bucket striking the ground. While the slag bucket was being emptied into a wheelbarrow, the water bucket was emptied into the sewer. The men on the roof then let go of the slag bucket, which swung out over the edge and descended again of its own weight.

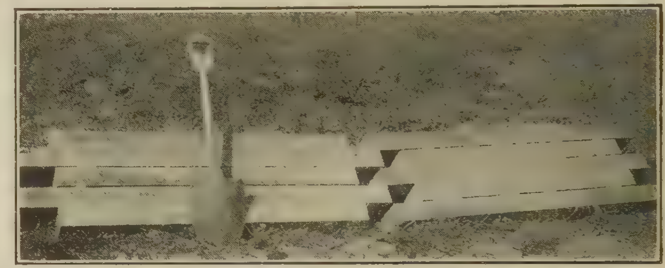
The "hydraulic mechanism" for filling the water bucket at the roof level consisted of a 50-gal. barrel placed in a horizontal position near the edge of the roof, and 3 ft. above it with its long axis parallel to the edge. A shaft was passed through the heads slightly off center, the shaft being supported in a frame which allowed the barrel to be revolved freely by a lever secured to one of its heads. Water flowed into the barrel continuously through a ¾-in. pipe under 50-lb. pressure. In the side of the barrel near one head was cut a circular opening to which a sheet-metal spout was attached in such a position that when the barrel revolved the spout would discharge into the water bucket. While the elevator was working the barrel would be turned with the spout up, so that no water was running out. When the slag bucket was filled, the barrel would be revolved until the spout was down, a relatively large volume of water running out of it and filling the bucket in a second or two.

Two men were required to operate the hoist, which averaged a full 2½-cu. ft. load on each trip. The maximum speed attained was two trips per minute, while an average speed of 65 trips per hour was kept up. As the men employed received 25 and 28 cents per hour respectively, it is seen that the labor cost of raising this slag was 12 cents per ton, allowing 55 lb. per cubic foot for the weight of the slag. The slag bucket was filled at the bottom from wheelbarrows.

Steam Shovel Turns Easily on Short Sections of Interlocking Track

By EDWARD W. GOLDEN
H. W. Golden & Son, Inc., Troy, N. Y.

INTERLOCKING timber track sections, which could be shifted under the machine in making turns, are being used on the writer's work in handling a 20-ton steam shovel, and have overcome most of the troubles previously experienced in moving and turning. The work on which this revolving steam shovel was being used at the time the runways were devised was in a section where lumber more than 2 in. thick was difficult to secure. In using two or more layers of 2-in. plank trouble arose at the joints, and unless great care was taken the wheels were apt to kick the runway out to one side. In going around a curve it was necessary to re-lay the track behind the front wheels for the course taken by the rear ones.



SECTIONS SHIFTED OVER ONE NOTCH TO MAKE TURNS

The runways, shown in the photograph, are made of 4 x 6-in. longleaf yellow pine timbers bolted together with thin spacing strips between them by three ½-in. bolts. Two types of track sections, one male and the other female, were used. The length of these sections would vary with the machine under which they were used. Those made for the 20-ton shovel were in lengths forming 4½ ft. of track, which made it possible to change a section between the front and the rear wheels. This is essential in going around the curves. There is enough play in the interlocking joints to take up a section and move it over one notch so that the rear wheel will run squarely on it.

The interlocking joint allowed the wheel to get a bearing on the track section ahead before it left the last one. By placing a short 2 x 8-in. plank under the joint, the shovel could stop and dig with any of the wheels over a joint and still be able to start again without difficulty. Although the timber used in making these runways was a little heavy, it proved very serviceable.

2,500,000 Square Yards of Wood-Block Paving Laid in 1916

Wood block paving to the extent of 2,500,000 sq. yd. was laid on city streets in 1916, it is estimated. Five cities laid more than 100,000 sq. yd. each. In addition about 1,000,000 sq. yd. was laid in factories.

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Dumping Platform for Electric Trains Fails

Accident at Disposal Dock for East River Tunnels, New York City, Costs Two Lives

The breaking of strap steel stirrups, in which two 24-in. I-beams from which a dumping hopper for electric trains was suspended, precipitated the hopper, one dump car and an electric locomotive to the deck of a scow below, killing two men and seriously injuring another, in the northerly slip of the Municipal ferryhouse at Broad Street and the East River in New York City on the morning of Feb. 12. This slip had been turned over to the Flinn-O'Rourke Company, Inc., contractors for the construction of the four downtown tunnels under the East River for the new dual subway system, and was being used to dispose of rock excavated from the southerly pair of these tubes.

As will be remembered from the article on page 810 of the Engineering Record for June 26, 1915, with which was published a drawing of the hopper structure that collapsed, material excavated from these tunnels was being hoisted by elevator shafts at Broad Street and at Whitehall Street to the level of an elevated structure about 320 ft. long built in front of the Municipal ferryhouse. The muck cars were hauled on top of this structure and through the second story of the ferryhouse to the northerly slip by electric locomotives operated through a third rail carrying current at 110 volts. Here the cars were dumped into two hopper structures which discharged into barges below. The outermost of these structures was supported on each side by a 24-in. I-beam. The inner ends of the I-beams were framed to the ferryhouse structure, while the outer ends were hung in ½ x 6-in. steel stirrups from 1⅞-in. diameter rods with turnbuckles attached to the lower flange of a transverse plate girder supporting the roof of the ferryhouse structure. Each I-beam was also supported in the same way by a 2¾-in. diameter rod from the lower flange of a second transverse girder approximately over the center of the hopper below.

The failure occurred early in the morning of a cold day under a live load of about 35 tons, the hopper and connections being designed for several times this load. It has ben suggested that, as the straps might have been forged at the job, presumably during cold weather in 1915, one or more of them might have been defective. In each case the strap broke at one of the sharp bends around the lower flange of the I-beam.

Concrete Institute Repudiates Joint Committee Report at Meeting

Slag Aggregates, Cost-Data Publicity, Cast-Iron Column Tests, Road Problems and Building Regulations Treated

Hardly was the ink dry on the report of the Joint Committee on Concrete and Reinforced Concrete before the American Concrete Institute, at its annual convention, Feb. 8, 9 and 10 in Chicago, approved materially less conservative practice. Although the vote to adopt the report of its committee on reinforced concrete and building laws and to pass it to letter ballot was passed by the narrow margin of thirteen to ten, apparently no one of the thirteen could be found at the subsequent meetings who would ask for a reconsideration and remove the apparent discourtesy with which the eight years' work of the Joint Committee is received by the organization which should be more interested than any other. At one meeting a motion prevailed to send out with the ballot all of the data supporting the report, and at another session it was voted to defer for one year the letter referendum.

For the six sessions thirty papers and ten reports had been provided, so that several times vital discussions, such as on the topic mentioned above, had to be curtailed. The attendance of the 270 persons registered varied from a handful to the roomful of more than 100 when concrete road problems were discussed Friday evening.

Building-Law Discussion

The report on reinforced concrete and building laws was presented by the chairman, J. H. Moore, chief engineer of the Turner Construction Company, New York. The report preprinted with a few minor changes was adopted. Several criticisms had been sent in. The regulations called for in the report with reference to flat-slab design differing from those of the Joint Committee were defended by A. R. Lord. He stated that additional data were now available; he felt also that the Joint Committee report regulations were too strict, contained too many arbitrary rules and were too conservative, calling as they do for factors of safety of six or more, while in the proposed regulation they would be cut to four or less. The proposed regulation followed the Chicago code and was found to work out satisfactorily, while every building in Chicago would be condemned by the Joint Committee restrictions.

Prof. A. N. Talbot vigorously defended the latter, and T. L. Condron brought in a table showing that the proposed regulation was identical with the Chicago ruling as far as total moment is concerned, while the Joint Committee calls for a moment 19 per cent above the Chicago ruling. Considering the difference on allowable stresses the Joint Committee's recommendations require 35 per cent greater strength than the Chicago ruling.

Prof. W. K. Hatt indicated that there would soon be available information from an experimental flat slab of four panels built on the Smulski system at Purdue in November. Ernest Ashton called attention to the fact that the two reports were prepared from different standpoints. The Joint Committee report he considered in the nature of a treatise from the theoretical standpoint, while the other is for the practical purpose of a building regulation.

Ernest McCullough's paper on "Building Codes for Small Towns" ended with the conclusion that this should all be handled by a state code.

Slag Aggregates Good

"Slag and Cinder as Aggregates," the subject of a paper by Sanford E. Thompson, contained the results of tests on three samples of slag made by his office for the Stone & Webster Corporation. The tests at twenty-eight days indicated strength 50 per cent in excess of a gravel concrete, but the porosity of the slag required 15 per cent more cement. Careful examinations in various cities did not, he said, disclose evidences of deterioration where Portland cement had been used, but trouble had been experienced with slag cements. R. L. Humphrey stated that in Philadelphia there had been difficulty in getting slag of the right weight and low sulphur content. Furthermore, there were usually a material shrinkage and a difference when the slag and cement were mixed before and after adding water. He is of the opinion users should go slow until there are more tests.

Mr. Thompson's committee report on concrete aggregates was received as information.

Make Cost Data Public

That cost data are valueless if kept a secret and that contractors should give their costs the widest publicity were the contentions of Leslie H. Allen of the Aberthaw Construction Company in his paper on "Cost Accounting for the Contractor and Its Relation to

His Organization." An extended abstract of this paper appears elsewhere in this issue.

Frank B. Walker in discussion stated that the one thing that makes the contracting business of to-day the hazardous profession it is, and the one thing that has reduced competitive bidding to almost a dead-loss basis, is the limited knowledge of costs possessed by a great many contractors and estimators.

C. A. Crane, secretary of the General Contractors' Association, New York, discussed the relation of the engineer and the contractor. His discussion is also abstracted elsewhere in this issue.

Roads

At the highway session, the most popular meeting of the convention, five papers and a report were presented. The latter, on concrete roads and paving, presented by A. N. Johnson, was adopted and ordered sent to letter ballot. Changes made include the increasing of the coarse aggregate from 1½ to 2 in., and the retention of the one-minute period for mixing as the only requirement.

Mr. Johnson also gave a description of the condition of the Wayne County roads. All but three sections, aggregating less than 3 miles, were in good condition. He gave the details of the three defective strips and how they had been repaired. He does not consider a cracked block defective, and it would not be so considered except for the visual effect of the method of maintenance. Woodward Avenue, one of the first roads built in 1909, has, it is estimated, carried 7,000,000 vehicles.

William M. Acheson, division engineer, New York State Highway Department, gave a general review of the practice in his state of concrete-road construction and maintenance. W. Leroy Ulrich, Connecticut State Highway Department, emphasized the maintenance factors in caring for some 50 miles built by the department in his state.

W. M. Kinney told of new methods developed during the last year—belt finishing, more attention to water, side-loader mixers, hand finishing for wide streets by lutes to stakes, a vibrator used in Dallas and the Baker finisher applied in Detroit. Edward Hines elaborated on the latter in discussion, declaring that a denser, harder and smoother finish could be obtained than by the usual methods.

Test Results

L. J. Mensch was down for a paper on the "Tests of Concrete Columns with Cast-Iron Cores." The time was short, so P. H. Bates, of the U. S. Bureau of Standards, showed photographs of the columns tested to destruction. The idea is that a hooped-concrete column with a cast-iron core will permit material reduction in size, a valuable asset in high-value districts. Ten of the columns, 12¾ in. in diameter and 8 ft. long, were tested and failed at an average stress of 12,000 lb. per square inch of core area. The columns can, he stated, be made to sustain stresses up to 17,000 lb. per square inch.

Earl B. Smith, associate mechanical engineer, U. S. Office of Public Roads and Rural Engineering, gave further data on the flow of concrete under stress, supplementing information on the same subject presented by him last year, as reported in the Engineering Record of March 4, 1916. From experiments in compression cylinders and on beams Mr. Smith concludes that the law of the flow of concrete is asymptotic and continues at a gradually decreasing rate, yet is an appreciable amount during three or four weeks, after which it continues more slowly for an indefinite period. The natural total shrinkage of dry concrete, with which flow is not to be confounded, is about 0.05 per cent in three months. The total net flow under load, exclusive of shrinkage, may be as great as 0.15 per cent, depending on the time, load and material. The combined flow and shrinkage, then, in a 20-ft. column not reinforced, if loaded to about 800 lb. per square inch, may be nearly 0.5 in. of deformation, and may produce, in a reinforced beam of 20-ft. span fully loaded, a sag of nearly 0.3 inch. Even the much smaller deformations, which Mr. Smith says are inevitable, may produce, if not anticipated and provided for, serious results in the setting of apparatus and machinery and in the alignment of shafting, and may easily cause other parts and members of the structure to be overloaded.

Sewers Get Attention

Sewer-design difficulties due to subways in New York were explained in a paper by Samuel D. Bleich, assistant division engineer, Public Service Commission, New York. The following essentials were given as to the proper design of inverted siphons: Complete separation of sewage, industrial wastes and storm water; simplicity of construction; slow and easy change in direction of flow at entrance and exits; easy curves; elimination of all features tending to obstruct flow, and of all movable parts and mechanical devices; easy access without impairing any of essential features; sufficient area of entrance and discharge openings so as not to cause any backwater, and avoidance of abrupt changes of section or direction.

The committee on concrete sewers, W. W. Horner, of St. Louis, chairman, brought in a proposed specification for monolithic concrete sewers which was received as information.

Chimney Design Needs Attention

Year after year the committee on chimneys has told what it was intending to do. J. W. Lowell, in discussing the report, deplored the apparent lack of design data or scientific treatment of the problem. He is of the opinion that walls should be kept as thin as possible even to allowing for tension in concrete. Reinforcing should be kept near the outside, within 2 in. He suggested closer study of vent holes in air spaces sealed off from flue to keep the stack cool.

Vibration has been studied during the past year by a questionnaire sent out by the Aberthaw Construction Company. M. C. Tuttle outlined the results, and mentioned heavier construction as the answer to the problem.

Two historical papers will, it is thought, make valuable reference additions to the Institute proceedings—one on "Piles," by Charles R. Gow, consulting engineer, Boston, and the other on "Unit Construction," by John E. Conzelman, civil engineer, St. Louis.

The officers elected for the ensuing year are as follows: President, W. K. Hatt; vice-president, Sanford E. Thompson; treasurer, Robert W. Lesley, of Philadelphia. H. D. Hynds, 30 Broadway, New York, is secretary.

Lane Approves Applications of Topographic Engineers

Applications of ninety-three topographic engineers in the U. S. Geological Survey for commissions in the Engineer Officers' Reserve Corps of the Army have been approved by Secretary Lane. The total number of applications for Army commissions thus far submitted amounts to 80 per cent of the topographic field force of the Geological Survey. The new corps is established in conformity with the general plan now being worked out by the War Department to organize and have instantly available for active service in time of need a large number of specially qualified men.

The topographic surveys and maps made by the Geological Survey are recognized as war necessities, and the Survey is now carrying on special field work in co-operation with the Engineer Corps of the Army to produce military maps. The field engineers of the Geological Survey are all men of special training and wide experience.

Waterworks Association Announces Nominees

The American Waterworks Association has announced the nominees for officers for the year 1917-18. The ballots, which have already been sent out to the members, will be counted April 28, and the result announced at the June convention. The nominees are: President, Theodore A. Leisen and Charles R. Henderson; vice-president, Charles R. Henderson and Allan W. Cuddeback; treasurer, James M. Caird and Arthur A. Reimer; trustees, Beekman C. Little, Henry B. Morgan and W. S. Cramer.

The name given first is in each case that suggested by the nominating committee; in the case of trustees, the first two names. The other names are by petition of twenty-five or more members. John C. Trautwine, Jr., named by the nominating committee for treasurer, declined to allow his name to be used, hence the names appearing for this office are both by petition.

Road-Builders' Convention Opposes Change in New Federal-Aid Regulations

Resolution to Remove Present Restrictions on Use of Patented Materials or Processes Is Defeated at Annual Meeting of American Road Builders' Association

Although opposed on the ground that it destroyed co-operation and hindered State officials in exercising their judgment in the selection of pavement types, that section of the new federal aid regulations governing the use of patented materials or processes on highways to be paid for, in part, by U. S. Government funds was indorsed at the opening session of the fourteenth annual convention of the American Road Builders' Association held in Mechanics' Building, Boston, Feb. 5 to 9, when a resolution calling upon the Secretary of Agriculture to rescind the clause in question was decisively defeated. Following an address in which Logan Waller Page, director of the U. S. Office of Public Roads and Rural Engineering, outlined the policy and program of the United States Government in road construction under the Federal-Aid Act (see page 259), L. D. Smoot, commissioner of public works of Jacksonville, Fla., presented a resolution calling for the elimination of the clause of the rules known as regulation 8, section 4, which reads as follows: "No part of the money apportioned under the Act shall be used directly or indirectly to pay or to reimburse a State, county, or local division for the payment of any premium or royalty on any patented or proprietary material, specification, process or type of construction unless purchased or obtained on open actual competitive bidding at the same or a less cost than unpatented articles or methods equally suitable for the same purpose."

Objections to Patented Materials Clause

To this portion of the Government's policy the first objection was made in a written communication from Col. E. A. Stevens, commissioner of the Department of Public Roads of New Jersey. The section referring to the use of patented materials or processes, according to Colonel Stevens, was adopted after the Association of State Highway Officials had been informed that it would have to stay, in spite of that body's previous unanimous vote advising its omission. The association, on being thus informed, suggested by a divided vote changes providing for competition. Such competition, Colonel Stevens stated, is impossible in the case of meritorious patents under any strict interpretation of the language used. "There are," he said, "some meritorious patents, and their use can be had on reasonable terms by honest and competent road officials. The practical denial of the right to bargain for such use would seem justifiable only on the assumption that State officials are either dishonest or incompetent. Such assumptions do not promote co-operation and teamwork."

F. A. Reimer, county engineer of Essex County, New Jersey, also spoke in opposition to the Federal Government's policy. He said, in part: "It is the most pernicious policy we have, by which you can introduce log-rolling in the governing board after the bids have been received. It will invariably be true that the unpatented material will be lower in price than the patented article and the engineer who has made the recommendation is put immediately at a disadvantage and oftentimes his recommendations are ignored, not because they are not right, but because of log-rolling which has taken place after the bids have been received."

Mr. Page inquired whether the free use of patented materials would eliminate log-rolling.

Another opponent was J. M. Head, chief counsel of Warren Brothers Company of Boston. In a number of States, according to Mr. Head, the laws expressly provide that the final determination of the kind and character of improvement, whether patented or unpatented, shall be determined upon, and specifications therefor adopted, before advertising for bids. The regulation, he said, presumed, in the face of express State laws and State Supreme Court decisions, that bids can be called for on both patented and unpatented articles before selecting the kind of improvement to be made. It assumes, also, according to Mr. Head, that some unpatented article is, in the opinion of the Secretary of Agriculture, "equally suitable" for the proposed construction.

Resolution Is Defeated

Mr. Smoot's resolution requesting that regulation 8, section 4, of the federal aid requirements be rescinded was referred to the committee on resolutions of the American Road Builders' Association, which, at a later meeting, reported unanimously against its adoption. The discussion then was re-opened. George C. Warren, of Boston, whose company controls the Bitulithic type of construction, expressed the belief that if the regulation is allowed to stand, such a State as New York would practically be prohibited from using any patented pavement. Nelson P. Lewis, chief engineer of the Board of Estimate and Apportionment, New York City, endorsing the action of the resotions committee, said that it would be "questionable and inexpedient" to urge upon the Secretary of Agriculture the recision of the clause relating to patented materials. He cited cases in which the City of New York had suffered from a reckless policy in laying patented pavements. The basic consideration in a matter of this sort, Mr. Lewis pointed out, is the protection of the tax-payer and it was his belief that the tax-payer could best be safeguarded by allowing the clause to stand in its present form. George W. Tillson, consulting engineer to the president of the Borough of Brooklyn, New York City, thought that the opponents of the patented materials clause in the Federal-Aid regulations were hasty in assuming that it would exclude their products. He thought it would be best to wait for a year and see how the matter worked out. It was finally moved by George C. Warren that the report of the committee on resolutions, advising against any change in the existing Federal-Aid Road Act, be adopted. The motion was passed unanimously.

The secretary's figures showed an attendance of between 3500 and 4000 at the convention, this number including guests and representatives of exhibitors. In the arrangement of the program generally one, and never more than two, formal papers were assigned to each session, the idea, as expressed by Colonel W. D. Sohier, being to give ample time for discussion from the floor. The large attendance at the meetings and the interest manifested were an unqualified indorsement of the plan followed. Most of the papers are abstracted elsewhere in this issue and will not be dealt with in this report.

At the opening session, with President Arthur W. Dean presiding, Director Page, of the Office of Public Roads, defended the Federal-Aid Road Act against criticisms of "pork-barrelism." He pointed out that the policy adopted is one which encourages self help and discourages paternalism. From the point of view of the pork-hunter, he said, no measure is attractive which requires the State to contribute an amount of money equal to that appropriated by the Federal Government.

Road Maintenance

In the discussion of Prof. R. L. Morrison's paper on earth and gravel roads (see page 257), the opinion seemed to be unanimous that the patrol system of maintenance is without a peer for these types of construction. One man must be made responsible for each section of road and means must be taken to instill into the maintenance force pride in their work.

The paper by W. R. Farrington of the Massachusetts Highway Commission (page 256) started discussion on the maintenance of bituminous surfaces. A great deal of trouble has been encountered in keeping the shoulders of such roads in repair. R. A. Meeker, chief engineer of the New Jersey State Department of Roads, questioned the advisability of spending money for concrete curbs at the edges of bituminous surfaces. He was of the opinion that these funds could be employed to better advantage in building roads of greater width. No trunk highway, Prof. Arthur H. Blanchard said, should be less than 18 ft. in width.

The Massachusetts Highway Commission, according to Mr. Farrington, has had considerable success with the use of a tar-sand mastic by the penetration method. This treatment is generally applied by hand pouring, hot sand being introduced into cans containing the bituminous material. Unless it is agitated, however, the sand settles and it is hard to maintain the mixture of uniform consistency. Philip Sharples, of the Barrett Company, told of efforts which are being made by his organization to develop a machine for applying this mastic.

Breed Discusses Concrete Roads

A wide variety of questions were answered by H. E. Breed after reading his paper on concrete roads (see page 258). There was a difference of opinion as to the merits of hydrated lime for concrete roads. W. T. Chollar, of the Atlas Portland Cement Company, stated that tests conducted by Henry G. Shirley of the Maryland State Department of Roads, led him to believe that there was no necessity for using hydrated lime, and that a concrete mixture of 1:1½:3 could be depended upon to give good results. The case for hydrated lime, however, was not thus summarily dismissed by E. S. Larned of the Lehigh Portland Cement Company. He called attention to the articles which have been appearing recently in the technical press on the dangers of too much water in concrete. In road work the tendency is to add water until a mixture will flow freely and work readily. It is possible, Mr. Larned pointed out, to reduce the amount of water and, by adding hydrated lime as a lubricant, secure a plastic concrete. The great advantage of hydrated lime, therefore, is that it produces a workable concrete without resort to an excess of water.

The concrete road is to be introduced in France at an early date, according to Mr. Chollar. He told of a French delegation which has just finished an investigation of concrete roads in this country and which, he said, will recommend this type of construction in the rebuilding of France after the war.

Granite Block

William H. Connell, chief of the Bureau of Streets, Philadelphia, described present practice in laying close-jointed granite block pavements. Steel-tired vehicles, he maintained, will soon be a thing of the past, so that one of the chief objections to granite block, noise of traffic, will become inoperative. Cement grout filler is best for granite block pavement, according to Mr. Connell, except in such cases as call for the use of the street by traffic before the grout has had an opportunity to set. Departing from the subject of construction proper, Mr. Connell made a plea for efficient paving inspectors, saying that good ones are worth at least $10 a day. He presented an elaborate table of paving costs, based on first cost and maintenance charges.

The subject of brick pavements was introduced by a paper by F. R. Williams, paving engineer of Cleveland, Ohio. An abstract appears on page 257. Will P. Blair, of the National Paving Brick Manufacturers' Association, cited cases to show that a sand cushion is not necessary to protect brick from damage by traffic. In Indianapolis, with the monolithic type of construction, there are no evidences of damage by impact. With the sand cushion, the full value of brick as a paving material cannot be realized. The monolithic type of construction is now recognized as best practice, according to Mr. Blair.

Contractors Discuss Motor Trucks

Contractors had an opportunity to discuss their problems following the paper by John H. Gordon, abstracted on page 260. Much of the discussion centered about the use of motor trucks and teams for haulage. It takes a contractor with a good deal of courage, according to Fred E. Ellis, manager of the Essex Trap Rock & Construction Company, to use a motor truck on new road work. Irregularities of the surface rack the machine and necessitate frequent repairs. On resurfacing jobs, however, the truck is a useful addition to the contractor's plant. Mr. Ellis believes that it is impossible to use both teams and trucks on one job.

Richard Hopkins, contractor, of Troy, N. Y., has found that mixed haulage on road work is possible if the motor trucks are given the right of way. A serious fault in most road work, he believes, is starting the job at the point farthest from the source of supplies. Mr. Hopkins has found it profitable to start work at the one-half or one-quarter point of the section, making it possible to do a good deal of the hauling over a finished road. In such cases, however, the contractor must warn his drivers to break track.

Earth Handling Problems

Eastern contractors apparently have not taken advantage of the Fresno scraper for preparing the subgrade of road. In intelligent hands, this is a most useful tool and, according to Mr. Hopkins, can be operated so as to leave the grade almost in finished condition.

T. J. Rockwood, contractor of Rochester, N. Y., prefers a 3½ to a 5-ton truck for road work. The larger truck, he has found, is unwieldy and in actual practice is seldom loaded to its capacity. There is a disadvantage also in the heavy truck in that it runs up bills for broken bridges and culverts.

Reverting to the subject of drag and wheel scrapers, Mr. Hopkins suggested the following as economical haulage lengths: wheel scraper, 500 ft.; Fresno scraper, 150 ft.; drag scraper, 90 ft.

That road-building is to assume a new importance in Canada after the war is ended was made clear by the remarks of J. Duchastel, city engineer of Outremont, a suburb of Montreal, and president of the Dominion Good Roads Association. Canada is now at work on various colonization schemes for returning soldiers, but a movement is now on foot to organize a vast road-building campaign upon which the men returning from the European trenches will be used in large numbers. The munition factories also must be reorganized and many men will be out of work. Unless Canada adopts measures which will give them employment, said Mr. Duchastel, there will be a move across the border into the United States in search of employment. This condition, Mr. Duchastel stated, must be prevented, for Canada needs her men. Road-building, he said, seems to be the solution to the employment problem after the war.

Traffic was the final subject of the convention and was discussed in a paper by D. B. Goodsell, assistant engineer, Department of Public Works, Manhattan, New York City (see page 260). Mr. Goodsell spoke of congested conditions of the streets in New York City and gave advice as to the selection of the type of pavement with respect to the character and volume of traffic which it will carry. In Massachusetts, according to Col. William D. Sohier, the permissible wheel loading is 800 lb. per inch width of tire, but an effort is to be made to reduce this amount. There is also under way an attempt to limit gross loads to 8 tons.

The entertainment features of the convention included a smoker by the Massachusetts Highway Association, a banquet, and a reception and ball. Moving pictures of the Columbia highway were shown by S. D. Lancaster.

An extensive exhibit of road-building machinery and materials was held in the Mechanics Building. It is described in another column of this section.

Concrete Machines and Cement Products Exhibited

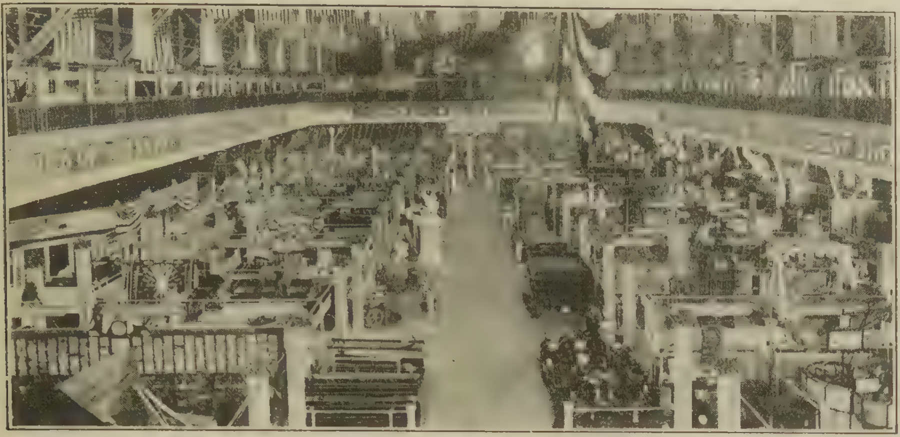
Chicago Cement Show Presented Few Decided Novelties, but Was Replete with High-Grade Standard Outfits

The freak exhibit is no longer seen or heard at the Chicago Cement Show. The tinware mixer man and the man who dealt in secret compounds for producing superconcrete have gone to other places. Perhaps this statement is not completely true, but at the exhibition just ended one had to search far to find a featured device or material not to be commended as truly serviceable to the concrete constructor. The practical serviceability of the exhibits was the broadly outstanding feature of the Chicago Cement Show of 1917.

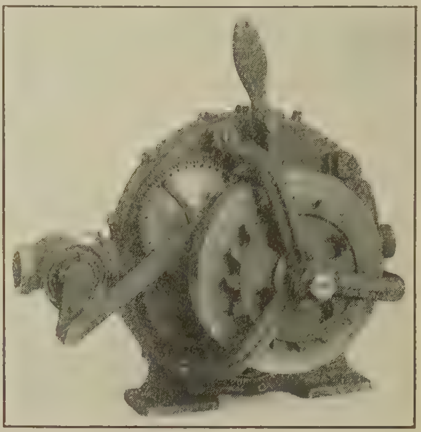
Joint Exhibits a Feature

Two groups of industries, the cement manufacturers and the associated manufacturers of concrete mixers, made joint exhibits. Under the direction of the Portland Cement Association a score of grouped booths at the north end of the building displayed concrete materials and cement products by pictures, models and sample articles. This exhibit served the contractor best, per-

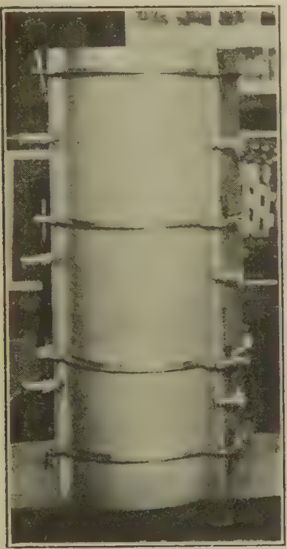
New Machines at Chicago Cement Show



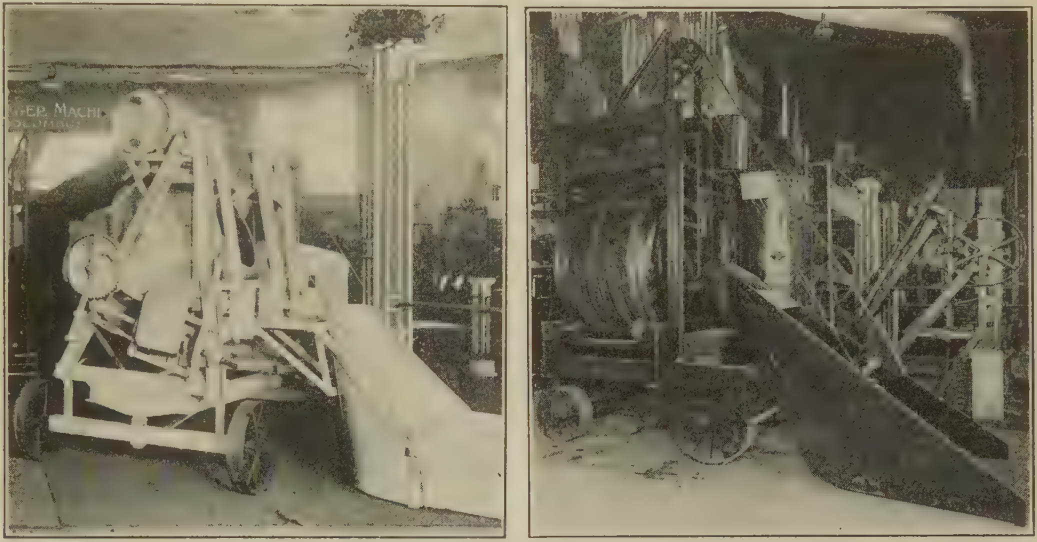
GENERAL VIEW OF CHICAGO CEMENT SHOW OF 1917



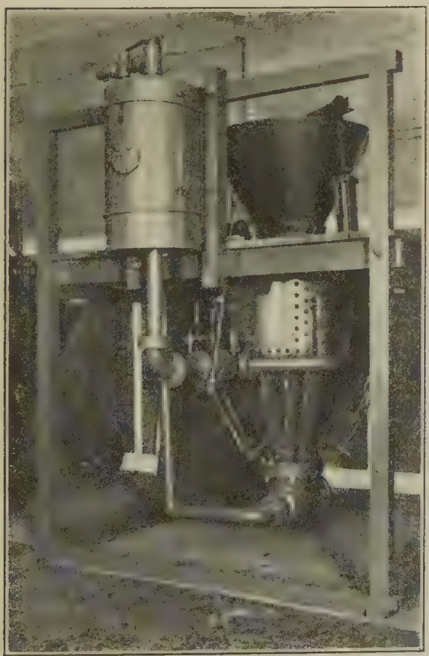
AUTOMATIC WATER REGULATOR



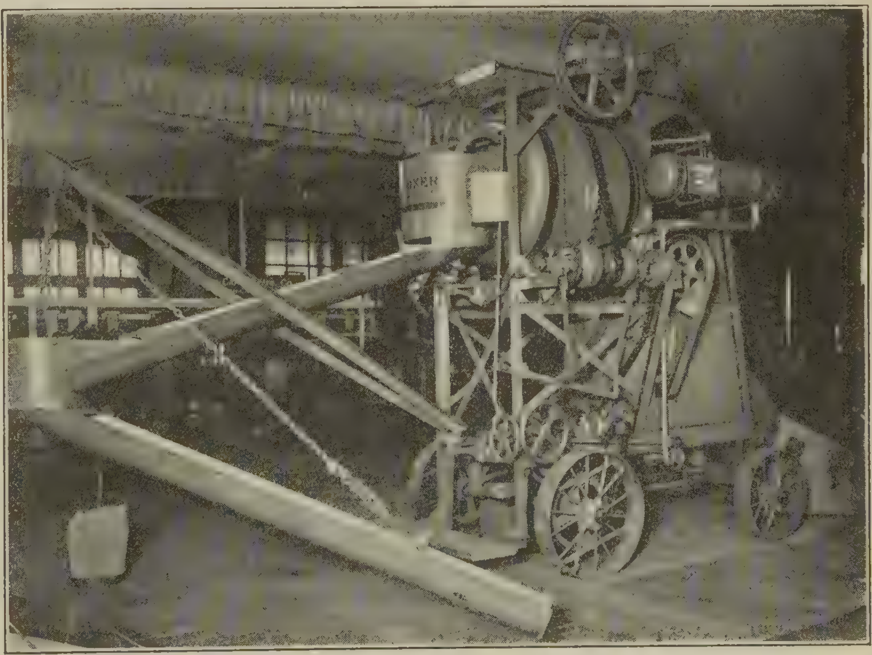
SECTIONAL COLUMN FORM



TWO MODIFIED TYPES OF MIXERS DEVELOPED MAINLY FOR BUILDERS



PREMIXING PNEUMATIC MIXER



NEW PAVING MIXER WITH 16-FOOT HINGED SPOUT haps, in its illustrations of poor and good aggregates for concrete and of crushing tests of concrete cylinders made from good and poor sand and coarse aggregate. The spectacular feature of the exhibit was a full-size section of concrete road with pictured background and other theatrical properties.

The other grouped exhibit, that of the National Association of Mixer Manufacturers, made up for its lack of scenic appeal by the impressiveness of the machines exhibited. Half a dozen or more large pavers were scattered about the exhibition space.

Pneumatics and the Concrete Worker

Mechanically, the features of the great mixer exhibit were the machines for mixing and placing concrete by compressed air. They ranged from the little truck portable pneumatic stucco placer to the larger "cement gun," the still larger grouting machine and the machines standing 10 ft. tall for mixing and shooting by compressed air half-yard batches of concrete. Air pressure as a means of mixing and placing cement and mortar and concrete mixtures has arrived after a dozen years of active experimentation and increasingly successful use in actual construction.

Comparison is dangerous, but among machines for the concrete worker the mixers made the largest showing. Mention has been made of the large pavers. Quite as significant progress was to be noted in the opposite direction. Small mixers, the little 4-cu. ft. machines, were greatly in evidence. The large makers have turned their attention to the making of mixers of small sizes, and in strength and good mechanical design these little mixers exhibited high qualities.

A hasty count showed a dozen exhibits of motor trucks. These were all machines designed for contractors' haulage, and they made the most notable exhibit of the kind that has appeared at any Cement Show. A brief study showed no radically new developments, but a general improvement in mechanical details and evident effort better to meet the requirements of the contractor in motor-truck construction and operation.

Preparation of Aggregates Featured

Beginning with the exhibit of the Portland Cement Association, which displayed samples of good and poor aggregates, the exhibits of ways and means available for handling and preparing aggregates were numerous. Besides crushers and screens of the types usual to gravel and crushed-stone plants, there were shown various forms of dragline scraper outfits designed for excavating, screening and storing sand and gravel on the job. This last development in the concrete workers' field plant has advanced rapidly during the last two years. Where gravel and sand are locally available contractors for concrete structures will find at hand a number of types of field outfits that have been well tried out and will meet most conditions of output and cost.

Steel Forms

Exhibits of steel forms for the concrete worker have in the last few years at the Cement Show decreased in number and increased in importance. At the 1917 show few companies showed steels forms, but these firms exhibited comprehensive lines. Steel-form construction as it was exemplified at the recent show presented two salient features. Great advances were shown in standardization of construction and, particularly, in increased adjustability of forms. Column and wall forms, curb and gutter forms and conduit forms in particular are now being made in units, with standard fastenings and bracing, which can be assembled in ways to give various combinations of sizes and shapes.

The feature of the Chicago show of 1917 was not as has been already stated the new machines and devices exhibited, but the higher standards of design, materials and workmanship shown by the old familiar machines. Perhaps half a score would number all the new machines of sizes which were exhibited. In the following paragraphs several of these novelties are described.

Precast and Ornamental Concrete

Ornamental concrete is now firmly established as a practical and economical part of modern construction, and in the joint exhibit of the Portland cement companies and the booths of some of the specialty manufacturers were displayed precast products ranging from column caps to the highly ornate mantel. Of special interest is the degree of perfection attained in the reproduction of stone and marble faces, so true to the natural products as to require close inspection to determine the fact that the objects exhibited were in reality concrete. By the use of crystalline minerals, marble dust, richly colored gravels, etc., effects have been gained of surpassing beauty, and at nominal cost.

As a business getter the Cement Show of 1917 made a record. The visitors included an unusual number of contractors out to investigate concrete machines and to buy.

New Machines

The outstanding feature of the new Rex paver is the location of the drum high enough in the air to get a good angle of discharge with long discharge chutes, doing away with the use of a discharging boom. It cuts down the amount of machinery connected with the machine and makes a gravity mix. The paver is equipped with a 16-ft. lateral spout, the outer 8-ft. extension being swiveled. The whole spout may be turned on a pivot, the outer end covering the entire width of a 30-ft. street. The angle of the spout is 18½ deg. The over-all height is 12 ft. 1¼ in. While the machine is set high in the air the center of gravity is very low, so that there is no likelihood of the machine tipping over on rough ground. The paver is built by the Chain Belt Company, Milwaukee.

Premixing Pneumatic Mixer

The new pneumatic concrete mixer exhibited by the Ransome Concrete Machinery Company, shown by the accompanying illustration, combines the various features of the Buzzell, Larkin and Caniff patents, developed in connection with grouting and stuccoing devices. The new mixer is made in 1/3, ½ and 1-yd. sizes, the ½-yd. size being best adapted to a large variety of work. The feature of the mixer is the complete mixing of the material in the drum before it is discharged into the conveying pipe. By means of the several jet pipes entering the bottom part of the body, air and water together are forced into and through the materials, producing an active ebullition which mixes them thoroughly. Then the discharge valve is opened and the air pressure in the drum, aided by the jet at the bottom, drives the mixed concrete through the conveyor pipe to the forms, the batch being still further mixed by its travel. The mixer-unit as it is set up on the job occupies a space 8 ft. square. It is 11 ft. high. A 6 or 8-in. delivery pipe is employed. The output depends upon distance of delivery, sufficiency of air pressure and facilities for charging, but up to 700-ft. delivery the ½-yd. machine is capable of a batch a minute.

New "Big and Little" Mixer

A new all-steel mixer of the familiar type built by the Jaeger Machine Company presents two improvements. The improved machine has a hinged power side loader. It is also dumped by power, the dumping operation being under complete control to permit complete or partial discharge. The new mixer, like the others of the same make, is particularly a builders' mixer, and precise control of the discharge permits loading wheelbarrows. Another feature directed to the service of the builder is a hoist connected with the power plant and mounted on the mixer forms.

New Column Form

One of the illustrations shows the essential features of the column form exhibited by the Hydraulic Pressed Steel Company. These features are the shell units, the clamps and the rings. The units are made of 20-gage metal and have a V-shaped edge the full length of each side. These units are pressed in one operation. The units are combined to form the various diameters of columns. When erected, the V-shaped edges fit together, and being all alike, the units are brought into exact alignment and no offset is left on the column to be chipped off when the forms are removed. The V-shaped edge also serves to stiffen the form vertically. Shafts of any height may be formed by using two or more heights of units, telescoping them where the lap occurs.

The units are held together with cast-steel clamps, tightened by means of a bolt and wing nut. The units are held in a circular shape, and the bursting pressure is resisted by circular bands or rings, made of 1½-in. T iron. They are rolled to fit the diameter of the column, and are made in sections corresponding to the width of the units. The rings are assembled in one piece and have one joint left unbolted, so that the ring may be placed on the shaft form. A tool called a ring handle, acting on the lever principle, is slipped into the slots on each side of the joint, and the ring is pulled together, until the wedge slots register. A pointed wedge is then driven through these slots and the ring is brought to the exact diameter. The ring handle is then removed.

Automatic Water Regulator

There was also shown an automatic water regulator for supplying a predetermined amount to a concrete mixer. The meter is in effect a vane pump driven by a sprocket and chain placed on some moving shaft in the mixer. A regulating dial, indicating the amount of water which will pass at a given setting, is revolved by the sprocket through a train of gears until a lever controlling the outlet is released. The clutch is then disengaged until the lever is returned to the set position by the operator.

The meter is rated to discharge from 1 to 20 gal. in a maximum of 10 seconds. It can be connected to a pipe line or it will draw in water from an open tank under a suction lift of 8 ft. if necessary.

The Anderson meter, as it is called, has been tried out for a year on various mixers. It is made by the Municipal Engineering & Contracting Company, Chicago, not only for the company's own mixers but for any style of mixer.

Road Exhibits Show Trend of Present Practice

Paving Materials and Construction Plant Displayed at One Hundred Booths in Mechanics Hall, Boston

With more than one hundred exhibits of road-building material and equipment on display, the Eighth National Good Roads Show, held in conjunction with the annual convention of the American Road Builders' Association, was staged on two floors of Mechanics Building, Boston, last week. The booths on the main floor were devoted largely to paving materials, the lighter types of construction plant and displays by State and municipal highway departments, while in the basement was assembled the heavy road-building equipment—motor trucks, pressure distributors for bituminous material, steam rollers, concrete mixers, tractors, trailers, portable compressors, crushing machinery, etc. To the throng of visitors which ebbed and flowed through the aisles around the exhibition booths, was afforded an opportunity of studying at close range the numerous types of pavement in use to-day for both heavy and light traffic and the machinery and materials which have been responsible for their development.

The displays on the main floor may be classified roughly under the headings of paving materials, including asphalt, granite, brick, wood block, bituminous forms of surfacing and concrete; construction plant, embracing excavating equipment, drills, pumps, shovels, etc.; and miscellaneous materials, such as steel reinforcement, culvert pipe, road signs, surveying instruments, and expansion joint fillers. In the basement, the exhibits divided themselves under the heads of transportation, construction and maintenance.

Paving Materials

The main entrance to the exhibition hall was flanked by the displays of the Dunn Wire Cut-Lug-Brick Company of Conneaut, Ohio, and the Warren Brothers Company of Boston, showing Bitulithic and Warrenite types of surfacing. In the Dunn exhibit, the monolithic and semi-monolithic types of construction, where the brick is laid either directly upon the green concrete foundation or upon a thin bed of sand-cement mortar, were featured. The Warren exhibit showed models and photographs of Bitulithic construction together with cross sections indicating the grading of the material to produce "inherent stability."

Of the exhibitors of asphalt, the U. S. Asphalt Refining Company featured Aztec products, Bithoslag and Bitosan construction. The Barber Asphalt Paving Company of Philadelphia showed photographs of portable mixing plants, heating kettles, asphalt repair wagons, etc., products of its Iroquois works. Photographs of streets on which their products were laid were shown by the Atlantic Asphalt Refining Company and the Standard Oil Company.

Close-Jointed Granite-Block Construction

Close-jointed granite block construction was illustrated by the Granite Paving Block Manufacturers' Association which had on display sections of pavement showing both bituminous and cement-grout filler for joints and the Compton form of construction, used in Baltimore, whereby a thin coating of asphalt is squeegeed over the surface of granite block and coated with fine gravel.

Bituminous treatment of surfaces was accounted for by the exhibits of the Willite Road Construction Company of New York, the Barrett Company, which had a number of pictures and models of Tarvia work, and the Franklin Contracting Company of New York, featuring National pavement. The feature of the Jennison-Wright Company's exhibit was a slab of Kreolite lug wood block. This was supplemented by numerous photos of treated wood block for bridge floors and city streets.

The Portland Cement Association featured concrete road construction. Brick of various kinds, impregnated with asphalt, were exhibited by the Aspha-Brick Corporation of New York.

Contractors' Plant

There was a large representation under the heading of contractors' plant and accessory equipment. The Orenstein-Arthur Koppel Company showed a model of an industrial trackage system and cars for hauling concrete aggregate or other material with dinkey locomotives. Steam shovel facts were disseminated from the booths of the Thew Automatic Shovel Company of Lorain, Ohio; the Bucyrus Company of South Milwaukee; the Keystone Driller Company of Beaver Falls, Pa.; and H. P. J. Earnshaw of Boston, who featured Erie steam shovels.

Pumping equipment formed a prominent part of the displays of the Harold L. Bond Company of Boston; the Clinton Power Pump Company of Clinton, Mass.; and the Edson Manufacturing Company of Boston. In the Bond exhibit there were also a portable air compressor and a model of a concrete chuting plant.

Miscellaneous Materials.

Among the displays of accessories to road construction was that of the Lebanon Machine Company of Lebanon, N. H., which comprised several types of cast-iron guide posts with white enameled lettering. The Concrete-Steel Company of New York City featured the Havemeyer bar road mesh, as well as round nose and angle curb bars. The Clinton Wire Cloth Company of Clinton, Mass., showed a full-size section of concrete road reinforced with its wire mesh. Culverts formed the most prominent part of the display by the Cast Iron Pipe Publicity Bureau of New York City.

Engineers have come to realize that the location of a road ranks in importance with its construction. For the locating engineer, the exhibit of W. & L. E. Gurley contained much of interest. There were transits ranging from the heavy to the light mountain type, levels, stadia rods, level rods and for those highway engineers interested in the preparedness movement, one of the latest designs of military sketching boards.

Two types of pre-molded bituminous filler for joints in pavement were shown by the Phillip Carey Company of Cincinnati, with its Elastite joint, and the Asbestos Protected Metal Company, of Pittsburgh, showing the Pittsburgh paving joint. The adaptability of the Pittsburgh joint material for wide variations in temperature was indicated by two specimens of the materials, one immersed in a brine mixture at 30 deg. Fahr. and the other in hot water. The hot specimen maintained its shape while the cold specimen exhibited no signs of brittleness.

A Few of the Exhibits at the National Good Roads Show

1—STANDARD OIL COMPANY, NEW YORK. 2—BARBER ASPHALT PAVING COMPANY, PHILADELPHIA. 3—ACME ROAD MACHINERY COMPANY, FRANKFORT, N. Y. 4—GOOD ROADS MACHINERY COMPANY, KENNETT SQUARE, PA., AND METROPOLITAN PAVING COMPANY, CLEVELAND. 5—ATLANTIC REFINING COMPANY, PHILADELPHIA. 6—HAROLD L. BOND COMPANY, BOSTON. 7—THE ENGINEERING RECORD, NEW YORK. 8—ASBESTOS PROTECTED METAL COMPANY, PITTSBURGH. 9—WYOMING SHOVEL COMPANY, WYOMING, PA.

In addition to the various commercial exhibits on the main floor were others by state and municipal highway departments. Among the states represented were Massachusetts, New Jersey, Maine, New Hampshire and Florida. New York City and Boston both had displays. The U. S. Office of Public Roads showed models of all standard types of construction, while the Massachusetts Institute of Technology featured its courses in highway engineering and research, one set of blueprints giving the results of tests of tractive resistance of vehicles on paving surfaces of different types.

Unusual durability for its product is claimed by the Wyoming Shovel Works of Wyoming, Pa., which had on display its chrome-nickel, heat-treated blades.

Heavy Motor Equipment

An indication of the extent to which motor-driven apparatus is used by the contractor of to-day in road-building was reflected by the exhibit of heavy equipment in the basement of Mechanics Hall. The International Motor Company showed a 5½-ton, 4-yd., back-dumping Mack truck. By means of inclined mirrors and electric lights, the gear-shifting scheme was plainly indicated. The Garford Motor Truck Company of Lima, Ohio, showed its huge new "road-builder" truck with 5-yd. back-dumping body. This machine runs on steel tires 20 in. wide for the rear wheel and 10 in. wide for the front wheel. A new feature is claimed to be the worm-drive jack shaft. Other large-sized back-dumping motor trucks for road work were displayed by the Packard Motor Car Company of Boston, the General Motors Company of Pontiac, Mich., the Sterling Motor Truck Company of Milwaukee, the Kinney Manufacturing Company of Boston, with a back-dump Kelly-Springfield dump, the Signal Motor Truck Company of New England, the White Company of Cleveland, and the Locomobile Company of America.

Light Trucks

A number of types of light trucks also were on exhibition. The Smith Form-A-Truck was shown in several styles, embodying the adaptation of a Ford car to the haulage materials. The Auto-Car Company, of Ardmore, Pa., also showed a light truck. The Duplex Truck Company, of Lansing, Mich., featured a Troy 5-ton, steel-body trailer.

While the transportation end of road construction was the largest feature of the downstairs exhibit there was a big display of construction and maintenance plant. Charles Hvass & Company, Inc., of New York, had a motor-driven sweeper and a large pressure distributor for bituminous materials. Plows and tractors, using kerosene fuel, were featured by the International Harvester Company, while a Socony distributor for penetration road work was an instructive feature of the display of the Standard Oil Company, of New York.

A wide variety of equipment was on hand at the booth of Dyar Supply Company, of Cambridge, Mass. There were a portable stone and gravel heater, an air compressor mounted on wheels, a Haiss digging wagon loader and a leaning wheel grader. Another elaborate display was that of the Kinney Manufacturing Company, of Boston, which, in addition to its large truck previously noted, showed a Jones road planer invented by the superintendent of streets of Waltham, Mass. This machine is a heavy cast iron frame with vertical teeth and adjustable blades for maintaining bituminous surfaces. There was also a huge distributor and oiler mounted on a motor truck chassis, the oiler being detachable in favor of a dumping body.

A portable rock drilling outfit was featured by Chris. D. Schramm & Sons, of Philadelphia; there was a No. 2 outfit for holes 6 ft. or less in depth and a No. 3 for holes up to 12 ft. A portable rock crusher was shown by the New England Road Machinery Company, while the New England Truck Company, of Fitchburg, Mass., had on display a large distributor for heated oil.

Concrete Mixers

Concrete road construction had several representatives among the exhibitors. The Koehring Machine Company, of Milwaukee, showed its huge pavers, embodying a concrete mixer and a boom and bucket distributing system. The Jaeger Machinery Company, of Columbus, Ohio, had on exhibition its new 6-ft. mixer on which the clearance has been reduced from the old value of 9 ft. 2 in. to 6 ft. 2 in. by altering the loading device. This machine, it is claimed, is particularly adapted, in addition to its regular uses as a concrete mixer, to forming a grout for brick or granite block pavement and also for mixing cold road oil emulsions. A huge 16-ton road roller with scarifying attachment was the feature of the Buffalo Steam Roller Company's display. Two types of concrete mixers were shown by the Lansing Company, of Lansing, Mich.

Open Columbia River Bridge

The interstate bridge across the Columbia River, connecting Vancouver, Wash., and Portland, Ore., was thrown open to traffic this week. The steel structure is 23,000 ft. long, including the approaches, and contains ten truss spans each 265 ft. 6 in. long, three truss spans each 275 ft. long and one girder span of 50 ft. One of the 275-ft. spans is a drawspan of the vertical-lift type, which can be raised to give 150 ft. clearance above high water. The cost of the bridge was $1,750,000.

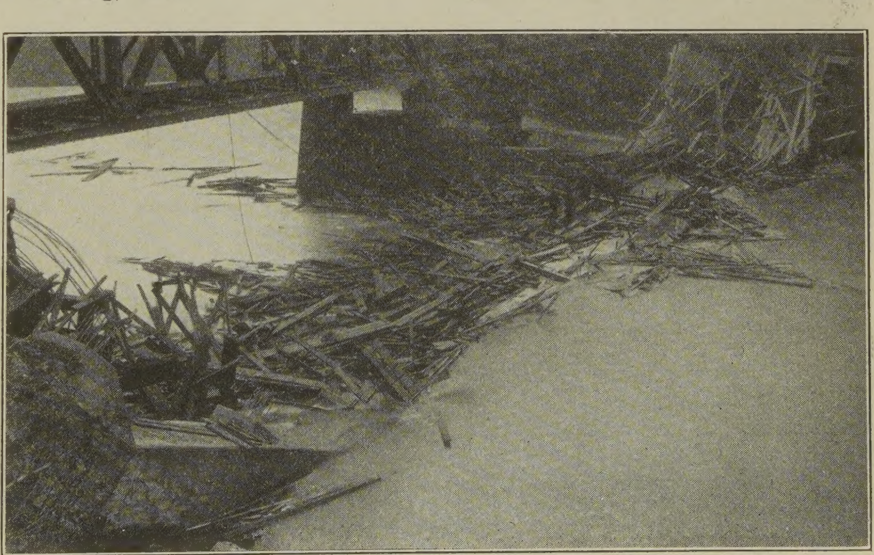
New Jersey Proposes Road Bill

Unless counties in New Jersey in their road building operations meet the standards of patrol systems and maintenance set for them in the proposed road bill to be presented to the Legislature they will be deprived of financial assistance from the State for their highways in case the bill is passed. At present the motor-vehicle fund of $1,200,000 is used exclusively for maintenance of highways, and the State annually appropriates $500,000 for new thoroughfares. This money, in the future, will be at the disposal of the proposed commission. No State aid will be given the counties unless they comply with all the requirements of the department for patrol systems and maintenance.

Falsework Failure Drops 250-Foot Arch Ribs Into River

Post Street Bridge in Spokane, Wash., Collapses During Construction and Three Men Lose Their Lives

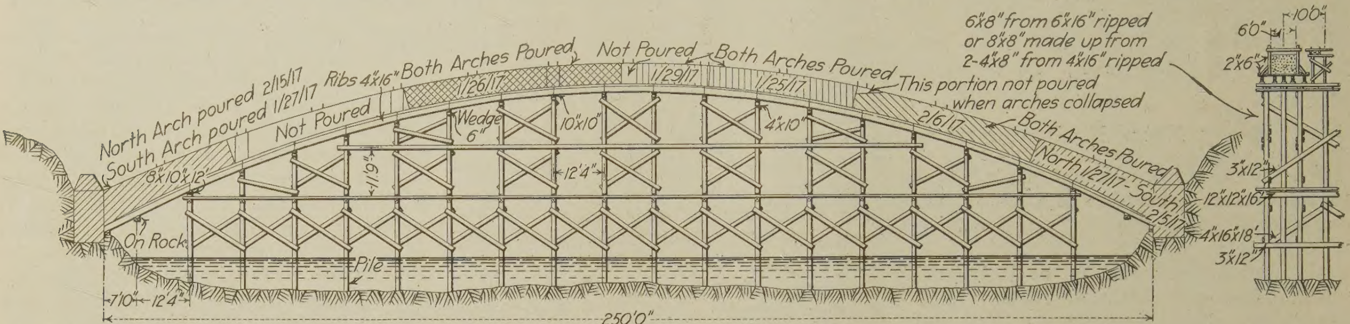
As noted briefly on page 242 of last week's issue, the falsework supporting the reinforced-concrete arch ribs of the 250-ft. span for the new Post Street Bridge in Spokane, Wash., collapsed suddenly on Feb. 6. Three men lost their lives and eleven were badly injured. According to the evidence reported to the city engineer, Morton Macartney, and furnished to the Engineering Record on request by S. Clark



ARCH RIBS OF 250-FOOT SPAN DROPPED BY COLLAPSE OF FALSEWORK

Patchin, the falsework fell straight into the river, as seen in one of the photographs, and the steel reinforcement was either pulled clean and bent down where the ribs broke or was broken in some cases.

According to the available information, no cause for the collapse can be given. Foreman H. O. McCall, superintendent on the work at the time and successor to P. F. Kennedy, who lost his life by falling from the bridge on Jan. 31, stated that the work had been proceeding smoothly according to the plans of Mr. Kennedy. Details of the falsework are shown on the drawing, the dates and location of the concrete sections placed up to the time of the collapse being indicated. The arch is 50 ft. high, and it was expected to pour the final sections on Feb. 7. The total weight of the collapsed rib is estimated at about 1500 tons.



DETAILS OF FALSEWORK THAT FAILED DURING CONSTRUCTION OF ARCH RIBS—DATES OF POURING SECTIONS INDICATED

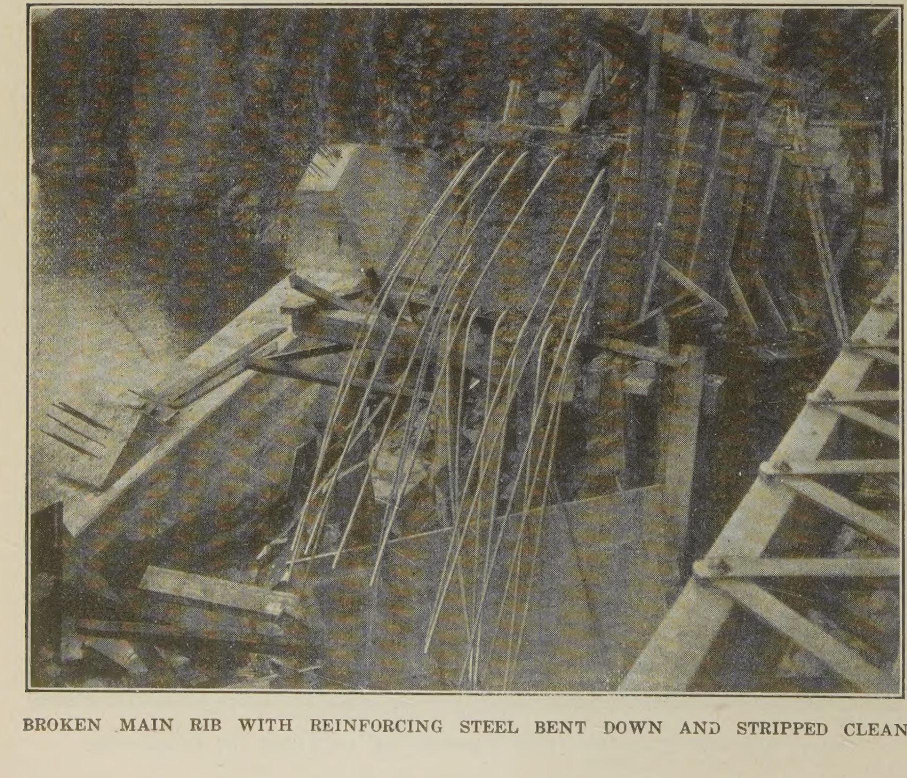
The contractors, Olson & Johnson, of Missoula, Mont., requested that the time for completion be extended to Nov. 15, but the city commissioners agreed that the $10 per day penalty would not be charged if the contractors went right ahead with the work. The contract price was $32,880, and the loss is estimated at about $10,000.

What Engineers and Contractors Are Doing

E. J. MEHREN, editor of the Engineering Record, has been elected first vice-president of the McGraw Publishing Company Inc., succeeding Hugh M. Wilson, resigned. He will continue as editor of the Engineering Record, devoting to each position half of his time.

J. G. WHITE & COMPANY, INC., announce the election of vice-presidents of the company as follows: Russell B. Marchant, formerly treasurer of J. G. White & Co.; Douglas I. McKay, formerly assistant to the president of J. G. White & Co.; Sanger B. Steel, formerly manager of Paine, Webber & Co., Chicago.

W. F. M. GOSS, dean of the college of engineering, University of Illinois, has resigned, effective March 1, to accept the presidency of the Railway Car Manufacturers' Association of New York. The aim of the association, which is barely a year old, is to represent the car building industry, to promote efficiency and to work for the standardization of parts and specifications. Since September, 1907, Mr. Goss has held the position of dean, as well as that of director, School of Railway Engineering and Administration and also professor of railway engineering. Graduated from Massachusetts Institute of Technology in 1879, Mr. Goss received the degree of Master of Science from Wabash in 1888 and Doctor of Engineering from the University of Illinois in 1904. In 1879 he organized the department of practical mechanics, Purdue University, where he later, 1890, became dean of the engineering school. He held this position until his appointment in 1907 to the University of Illinois. He held important posts in both the Chicago Exposition in 1893 and the St. Louis Exposition in 1904. He was chief engineer of the commission of investigation on smoke abatement and electrification of railway terminals, Chicago, 1913-15. Among the books of which he is the author are: Locomotive Sparks, Locomotive Performance, Superheated Steam in Locomotive Service, besides other books and many scientific reports and papers. No successor will be appointed to Dean Goss until the university board meets early in March.



BROKEN MAIN RIB WITH REINFORCING STEEL BENT DOWN AND STRIPPED CLEAN

C. F. HEALEY has resigned as special investigating engineer in the engineering department of the city of Chicago and has accepted the position of consulting engineer of the United Engineering Company, general contractors, Chicago. Mr. Healey was formerly district engineer on the construction of the Chicago, Milwaukee & St. Paul Railway (Puget Sound extension) and located some of the difficult portions of that line, notably the sections through the Hell Gate and Silver Bow canyons, Montana, and the western side of Snoqualmie Pass in the Cascades. Subsequently he was associated with Fuller & Manley, consulting engineers, Tacoma, Wash., and for a time was a member of the firm of Creelman, Putnam & Healey, engineers and contractors, Tacoma. Latterly he has devoted himself to increasing the efficiency of organizations and equipment, and this has been his special work with the engineering department of the city of Chicago.

EDWARD W. DAHL has been appointed city engineer of Yuma, Ariz., succeeding W. H. Elliott, resigned. Mr. Dahl was formerly engineer for Yuma County.